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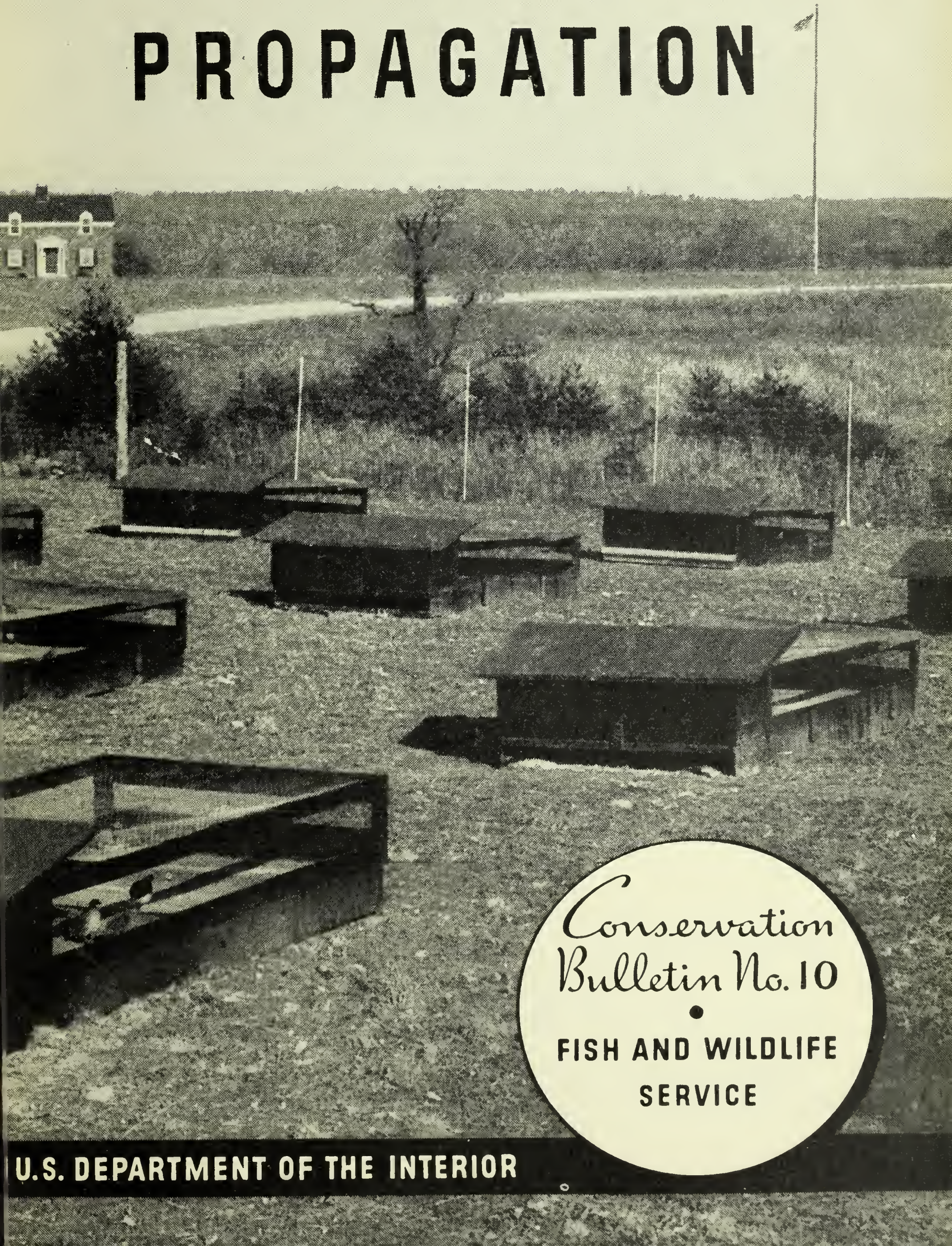
Bobwhite Quail
PROPAGATION



Conservation Bulletin No. 10

FISH AND WILDLIFE SERVICE

U.S. DEPARTMENT OF THE INTERIOR

CONSERVATION of natural resources is the motive underlying man's efforts in the field of game propagation. For more than half a century civilization has been reducing the numbers of wildlife, some to the verge of extinction, an extreme recent example being the heath-hen. Foresighted citizens have now come to realize that wildlife needs help, and with their awakened interest have stimulated an increasing number of farmers, 4-H Club members, and others to raise upland game birds in captivity. The bobwhite quail, one of the most popular and widely distributed of game birds, can be successfully raised in captivity for restocking depleted coverts. This bulletin gives the essential principles involved in its feeding and management.

UNITED STATES DEPARTMENT OF THE INTERIOR
Harold L. Ickes, Secretary
FISH AND WILDLIFE SERVICE
Ira N. Gabrielson, Director

Conservation Bulletin 10

BOBWHITE QUAIL PROPAGATION

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cooperating with the

Section of Food Habits, Division of Wildlife Research
Fish and Wildlife Service

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BOBWHITE QUAIL PROPAGATION

THE POPULAR BOBWHITE (*Colinus virginianus*) (fig. 1), known in the North as quail and in the South as partridge, is widely distributed throughout the United States. In the Gulf and South Atlantic States it is the principal upland game bird, and its range extends westward to the elevated central plains from South Dakota to Texas. In the Northeast, however, the bird's distribution is more restricted than some 50 years ago, and now it seems unable to survive in colder parts of New England where at one time it flourished. This withdrawal from the cold interior of the Northeast to the warmer coastal belt probably is connected also with the decline of agriculture in New England and the consequent nearly complete failure of the winter food supply. Introduction of the bobwhite west of the Continental Divide in Washington, Colorado, and Montana has met with moderate success, but plantings in California, Arizona, New Mexico, Utah, Wyoming, South Dakota, and Minnesota have failed.

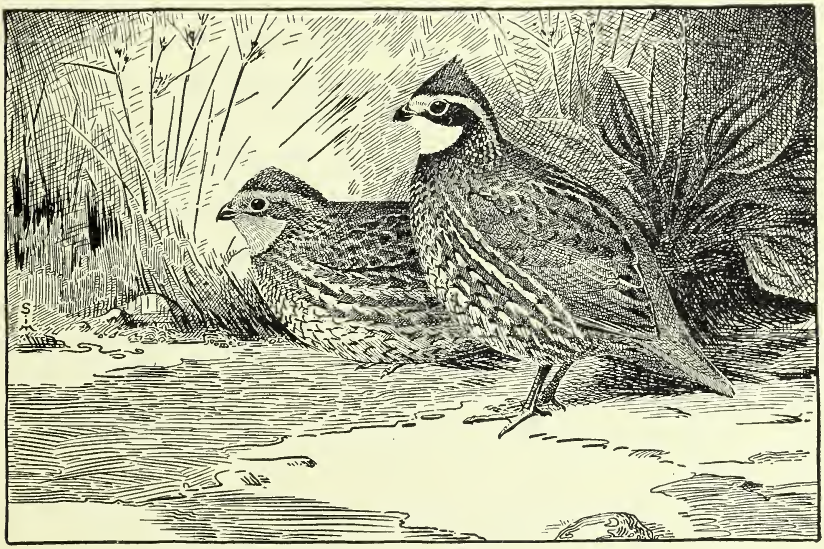

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***Figure* 1.—Bobwhite quails (male in foreground).**

That the bobwhite is amenable to rearing in captivity on a large scale has been demonstrated by many pioneers in the development of

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NOTE.—This publication is a contribution (No. 2) from the Patuxent Research Refuge.

propagation techniques, including electrical equipment. Their experiences have been a valuable background for the experiments on which this bulletin is based, conducted at the Patuxent Research Refuge, Bowie, Md.[1] By 1929, William B. Coleman, of Virginia, had succeeded in raising large numbers of bobwhites with electric incubators and brooders. Only a few years earlier all hatching and rearing had been done with bantam hens. At the close of 1938 the Bureau of Biological Survey (now merged with the Bureau of Fisheries to form the Fish and Wildlife Service) learned through inquiry that there were then at least 324 private breeders of bobwhites in the United States,[2] in addition to several State game commissions that were also experimenting in the propagation of these very desirable game birds.

PRELIMINARY CONSIDERATIONS

As most States require a license for the propagation of game birds and have regulations regarding their disposal, persons wishing to raise bobwhite should first consult the State game commission, which usually has offices at the capital.

In selecting a site for quail pens, an area on high ground, preferably with a slope toward the east, should be sought, and there should be no wet places nearby where mosquitoes might breed.

Game birds should not be reared near poultry or other domesticated birds because of the danger of contracting their diseases. Likewise, the vicinity of the pens must be kept free of manure piles, garbage heaps, and other sources of contamination. If the enclosure is at least 500 feet from sources of infection that might be transmitted by flies, the danger of disease will be much lessened.

It is desirable to enclose the quail area with a 6-foot chicken-wire fence[3] to keep out stray dogs, cats, and other animals, because game birds are easily frightened, and, when panic-stricken, fly violently against the wire ceiling of their runs, sometimes scalping themselves.

One man can successfully handle 40 pairs of breeding birds and their offspring at the height of the season. From this number at least 1,600 chicks should be raised to maturity. With a housing system like that described in this bulletin, 4,500 quails can be raised to maturity and 3,600 can be held during the winter on 1 acre. There should be 114 breeding pens for 1 pair each, and 60 brooding pens and 90 holding pens each of 40-bird capacity (fig. 2). This

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[1] Experiments were carried on jointly by the Fish and Wildlife Service, Department of the Interior, and the Bureau of Animal Industry, Department of Agriculture. For helpful suggestions in the preparation of this bulletin and for constructive criticism, the authors express their appreciation to Harry W. Titus, in charge of poultry investigations, Bureau of Animal Industry; to C. O. Handley, leader of the Virginia Cooperative Wildlife Research Unit; and to Frank C. Hanna and James Schwenck, quail breeders, of Oxford, Pa., and Petersburg, Va., respectively.

[2] Addresses of commercial quail breeders and of manufacturers of equipment for quail propagation may be obtained from the Fish and Wildlife Service, U. S. Department of the Interior, Washington, D. C.

[3] W. L. McAtee. Protecting Poultry from Predacious Birds. U. S. Department of Agriculture Leaflet 96. 1933. (Out of print—may be consulted at many libraries.)

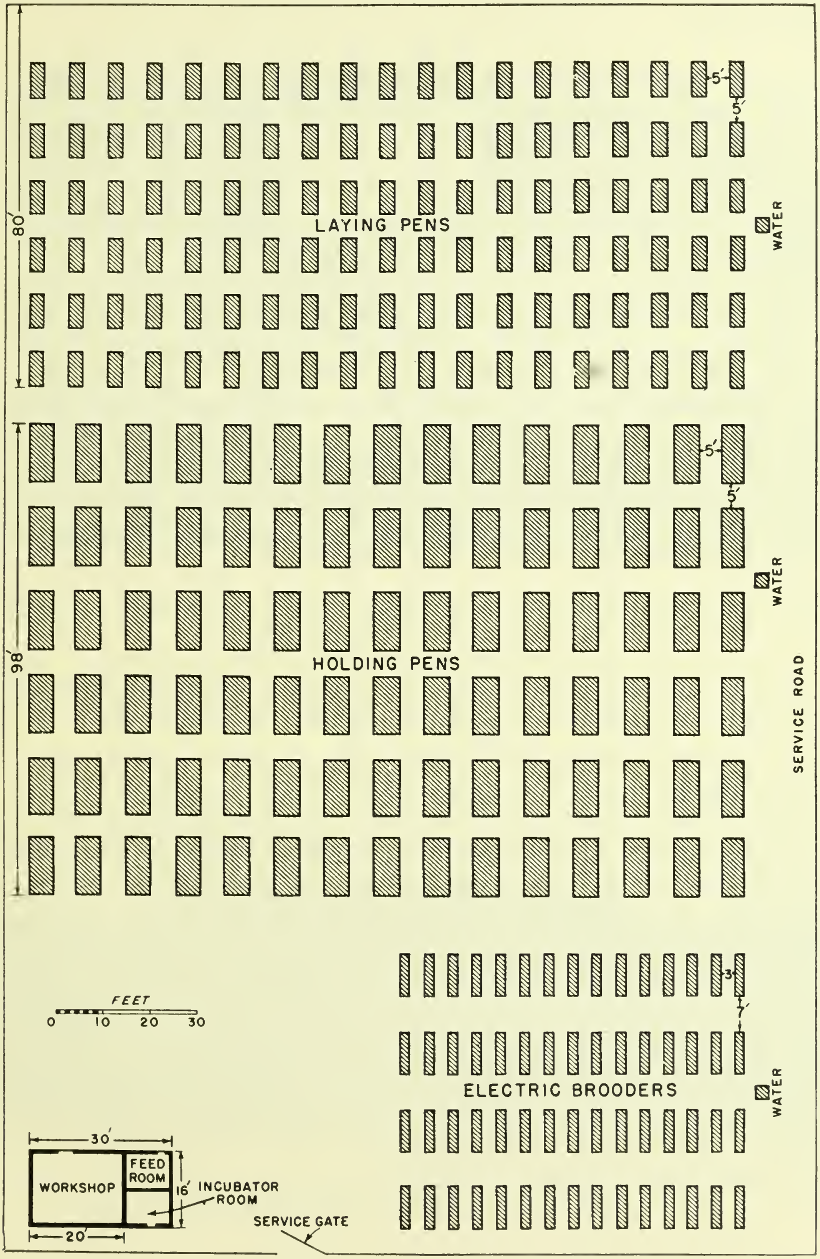

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Figure 2.—Layout of quail propagation plant on 1 acre.

system is based on the assumption that the breeder will dispose of part of his stock each fall. If he wishes to carry all his birds until spring, however, he can utilize the breeding pens as holding enclosures after the breeding season, not more than 15 adult birds being held in each.

BREEDING

Bobwhites are usually monogamous—one male mating with a single female. No rivals are tolerated. The sexes are alike in size, the average weight being about 6 ounces. The features distinguishing the sexes are the markings on the face and throat, which in the male are white and in the female yellowish brown.

SELECTION OF BREEDERS

The quality of breeding birds is a primary consideration for successful propagation. The importance of selecting large, healthy, vigorous, and early-maturing birds cannot be overemphasized. The offspring of producers having good records for fertility and hatchability usually turn out to be good quality producers. Two-year-old birds produce equally as well as yearlings, whereas older birds are not always dependable. It is well to carry the best yearling breeders over for a second year and replace inferior stock with offspring from the best producers.

Early in fall birds selected as breeders should be placed in separate pens isolated from the rest of the flock. This precaution often prevents an outbreak of disease wiping out the entire flock. It is wise to select a few more breeders than needed to guard against winter losses.

New blood should be introduced into the flock from time to time, because excessive inbreeding tends to lower fertility and hatchability and to weaken the constitutional vigor of the progeny. Close inbreeding, as brother and sister matings, will give poor results in the first generation. Bringing in new blood every three or four generations improves poultry. New blood can be introduced through trapping wild males, purchasing males from another propagator, or making exchanges between unrelated flocks. All new birds should be quarantined for a period of 3 weeks before being mixed with the flock, in order to detect sick birds, and thus prevent the spread of disease. Purchasing eggs from reliable breeders, however, minimizes the spread of disease.

HOUSING AND EQUIPMENT

Figures 3, 4, and 5 illustrate a type of breeding pen that has proved satisfactory in use at the Patuxent Research Refuge. It is a modification of one designed by James Schwenck, which would cost about $10, based on 1939 prices. A good preservative should be used instead of paint, except possibly for the top, to serve as a mite and

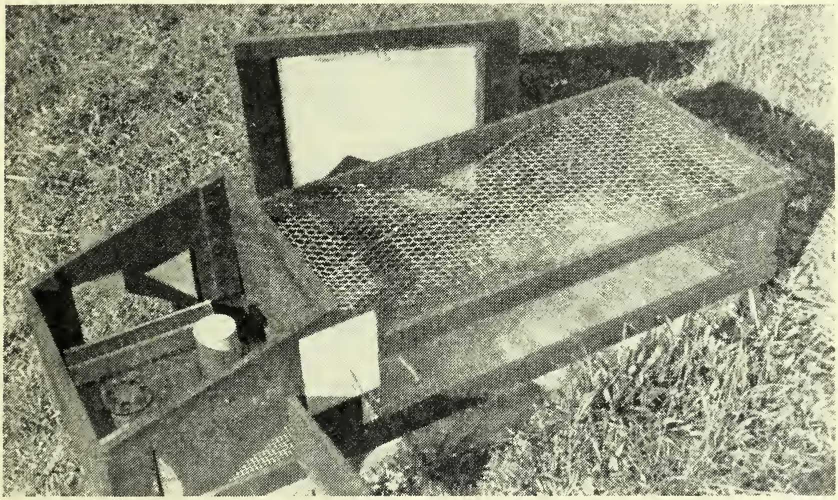
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Figure **3.—Single-compartment quail breeding pen used for 1 pair or as a holding pen for 15 birds in winter.**

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Figure **4.—Breeding pens in enclosure on the Patuxent Research Refuge, maintained by the Fish and Wildlife Service near Bowie, Md.**

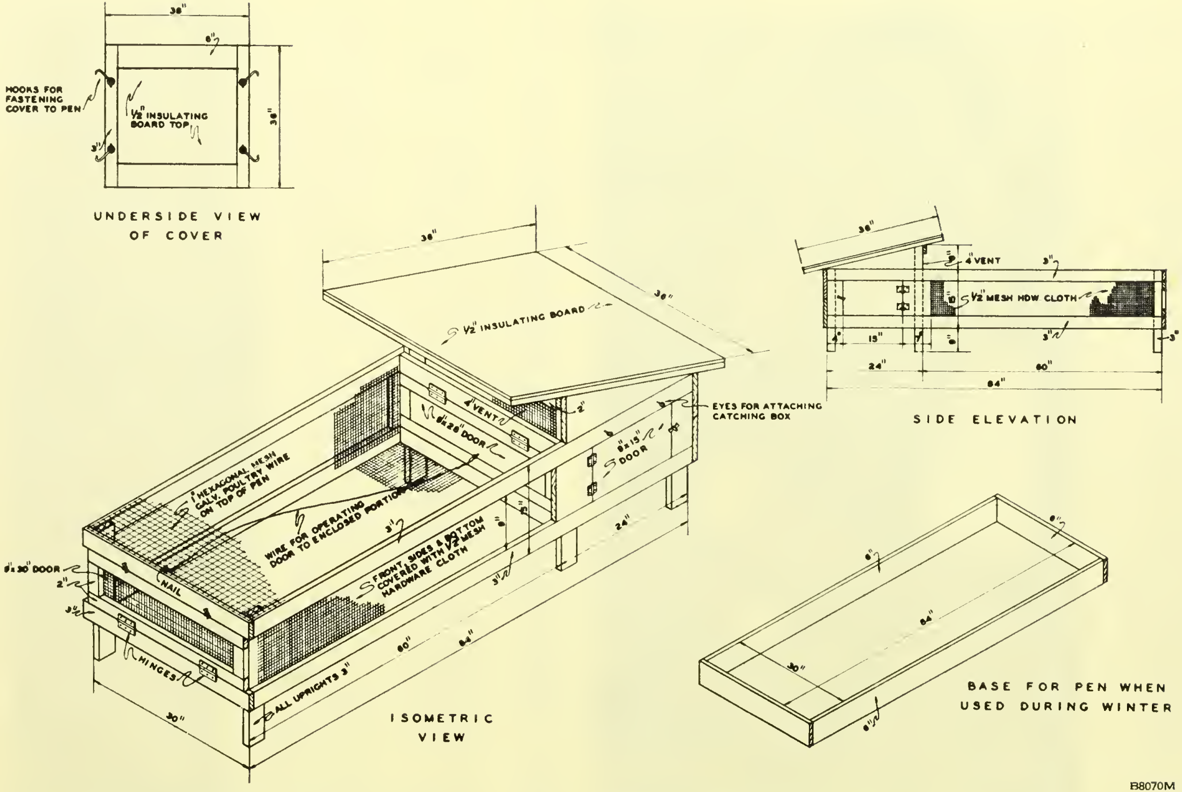
36"
6"
HOOKS FOR FASTENING COVER TO PEN
1/2" INSULATING BOARD TOP
3"
36"
UNDERSIDE VIEW OF COVER
36"
1/2" INSULATING BOARD
36"
1" HEXAGONAL MESH GALV. POULTRY WIRE ON TOP OF PEN
WIRE FOR OPERATING DOOR TO ENCLOSED PORTION
4" VENT
8"x28" DOOR
2"
3"
FRONT SIDES & BOTTOM COVERED WITH 1/2" MESH HARDWARE CLOTH
8"x15" DOOR
EYES FOR ATTACHING CATCHING BOX
8"x30" DOOR
2"
3 1/2"
NAIL
HINGES
6"
15"
24"
3"
60"
84"
30"
ALL UPRIGHTS 3"
ISOMETRIC VIEW
36"
4" VENT
3"
1/2" MESH HDW CLOTH
10
3"
4"
15"
24"
60"
84"
3"
SIDE ELEVATION
6"
6"
84"
30"
6"
BASE FOR PEN WHEN USED DURING WINTER
B8070M

Figure 5.—Construction details of quail breeding pen—of 7/8-inch lumber throughout.

louse repellant as well as a protective coating. Following is a list of materials needed in its construction:

BILL OF MATERIALS FOR QUAIL BREEDING PEN

- Lumber (⅞-inch material when not otherwise specified):
  - Frame:
    - 4 pieces, 3 by 84 inches.
    - 2 pieces, 3 by 31¾ inches.
    - 2 pieces, 3 by 30 inches.
    - 1 piece, 2 by 30 inches.
  - Shelter:
    - 1 piece, 15 by 31¾ inches, for back.
    - 2 pieces, 6 by 24 inches, for side.
    - 2 pieces, 7 by 9 inches, for side.
    - 2 pieces, 4 by 9 inches, for side.
    - 2 pieces, 3 by 36 inches, for top.
    - 2 pieces, 6 by 30 inches, for top.
    - 2 pieces, 9 by 15 inches, for small door.
    - 2 pieces, 2 by 28 inches for large door.
    - 2 pieces, 2 by 5 inches, for large door.
    - 1 piece, 9 by 28 inches, for large door.
  - Uprights:
    - 4 pieces, 3 by 21 inches.
    - 2 pieces, 3 by 27 inches.
  - Run:
    - 2 pieces, 2 by 30 inches, for door (end).
    - 2 pieces, 2 by 5 inches, for door (end).
- Lumber—Continued.
  - Base:
    - 2 pieces, 6 by 84 inches.
    - 2 pieces, 6 by 31¾ inches.
- Hardware cloth (½-inch mesh, for run):
    - 1 piece, 9 by 30 inches, for door.
    - 2 pieces, 12 by 60 inches, for side.
    - 1 piece, 30 by 84 inches, for floor.
- Miscellaneous:
  - Shelter:
    - 4 steel butts, 2 inch, for door (small).
    - 2 turn buttons, 2 inch, for door (small).
    - 2 spring hinges, for door (large).
    - 4 hooks and eyes, for top.
    - 1 piece insulating board (½ inch), 36 by 36 inches, for top.
  - Run:
    - 2 steel butts, 2 inch, for door (end).
    - 2 turn buttons, 2 inch, for door (end).
    - 1 piece hexagonal poultry wire 1-inch mesh), 30 by 60 inches, for top.

In figures 6 and 7 is shown a two-compartment breeding pen that has proved as satisfactory as one with a single compartment. It is made by inserting a movable solid panel, thus dividing the pen longitudinally in half. Two pairs of birds can be bred in the space otherwise occupied by one. It is important, however, that the partition be solid, so that adjacent pairs cannot see each other.

The distance between rows and between the pens in each row should be about 5 feet. This keeps the pairs far enough apart to prevent interference with mating harmony. Further, excitement affecting one pair does not spread to surrounding pairs, as frequently happens in closer quarters.

A strip of light-weight, smooth-surfaced roofing (35-pound, 3 feet wide) placed under the pen will satisfactorily care for droppings. This sheet will also keep down growths of grass and weeds. The legs of the pen will hold it in place.

Additional equipment for the breeding pens includes a nest box, a water fountain, a 10-inch feeder (or two if grain is fed separately), a

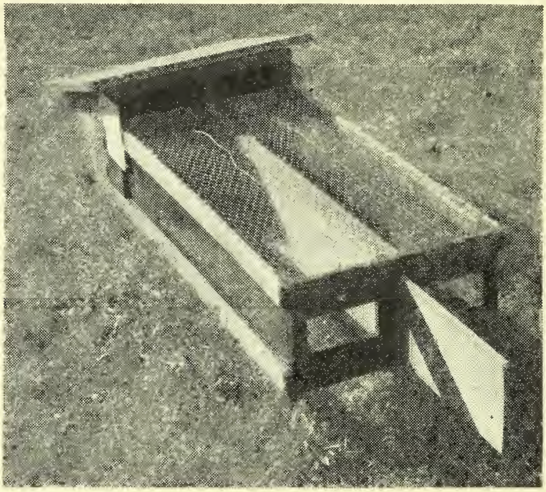

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Figure 6.—Two-compartment breeding pen that will accommodate 2 pairs during breeding season or 20 birds in winter. The removable center partition is shown partially drawn out.

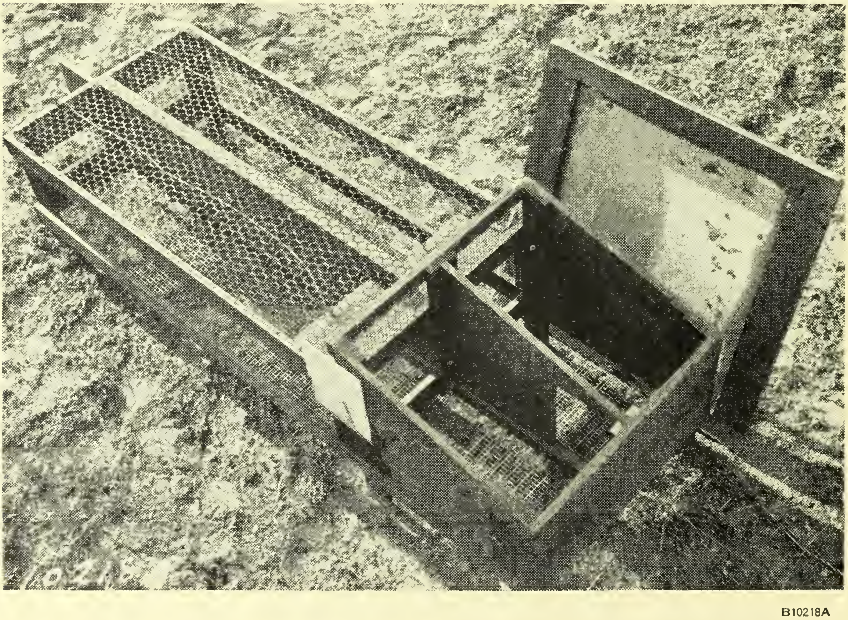

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Figure 7.—Rear view, from above, of pen shown in figure 6.

grit container, a dusting box, a record-card holder, and if desired also a receptacle for greens (fig. 8).

CARE OF THE BIRDS

DISTURBANCE

Since quails are nervous birds, every precaution should be taken to prevent their being disturbed. An attendant should announce his approach, as by singing or whistling. Dogs, cats, and other domestic animals should be kept away from the pens, the birds should not be handled, and care should be taken not to have a large number of visitors inspecting the pens at one time—their presence may mean loss of eggs. The sight or sound of paper, canvas, loose tin roofing, or similar things being blown about by the wind may cause the birds to become panicky and thus result in lowered egg production.

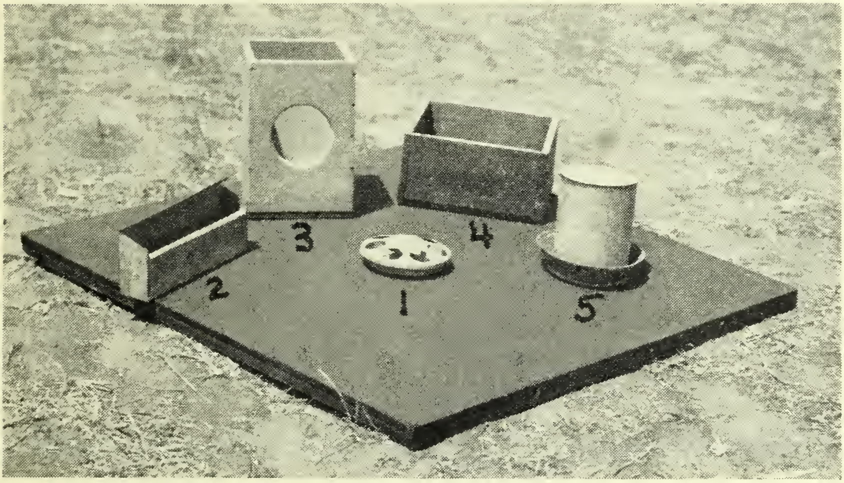

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Figure **8.—Equipment for breeding pen: 1, Chick feeder, 6 inches in diameter, with removable top, for feeding grit; 2, wall feeder 2⅛ by 10 by 5 inches high, for feeding dry mash; 3, nest box; 4, dust box; 5, water fountain, 2-quart capacity.**

SANITATION

Droppings under the pen should be removed regularly, say every 2 weeks. On some occasions, however, as after a rainy period, it may be desirable to remove them more frequently. Feeding and watering devices should be clean. Clean, fine sand should be kept before the birds for use as a dust bath as it tends to prevent infestation by external parasites. If the birds show signs of lice, however, dust them with sodium fluoride, applying a small quantity at the vent, on the breast, under each leg and wing, on the back near the tail, and also near the head and around the neck.

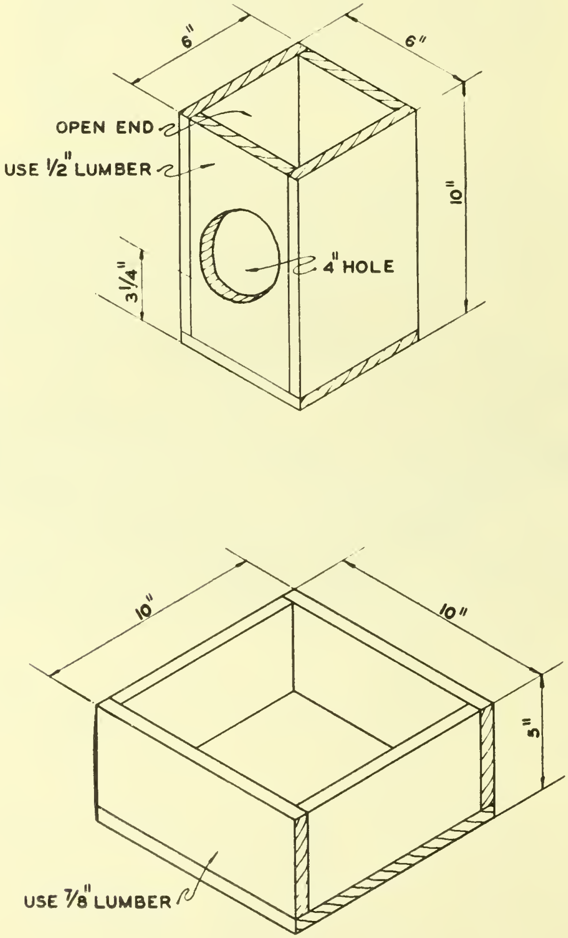

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Figure **9.—Construction details of nest and dust boxes shown in figure 8.**

LEG BANDING

If a breeder wishes to study the performance of his birds, to improve them by selection on the basis of egg production and hatchability and the vitality of the young birds, leg banding is desirable. Numbered aluminum bands, ¼ inch wide and $\frac{3}{16}$ inch inside diameter, can be purchased from many manufacturers of bands for poultry.

EGGS

Fine excelsior is excellent nesting material for quails, and enough should be placed in the nesting box for the nest to be built in the center of the mass rather than on top of it. Eggs should be removed for incubation once a week, preferably on Monday. Because germination of fertile eggs starts at 69° F., some breeders, to prevent partial incubation by summer heat, have tried removing them every day, as is done with chickens, and storing them in a cool place, but the desirable features of this method may be counterbalanced by its adverse effect on the hen. Although captive, a quail is still a wild creature, and it may be thrown out of routine by the daily disturbance and loss of its eggs. Even a weekly visit by an attendant causes some birds to seek other quarters for nesting—perhaps the dusting box or a corner of the pen. A nest egg, generally the first, should be marked and left in the nest for the season. If the breeder is pedigreeing his stock, he may mark the hen's leg-band number on the egg near the small end, using a soft lead pencil. Eggs are usually set but once a week, but if they are held longer, the first week's collection should be stored in a cool place, preferably at a temperature of 50° to 55° F., and turned at least once a day. Weekly settings, however, make for best results.

FEEDING

WATER

A constant supply of clean fresh water should be kept before the birds at all times. With domestic fowl, and probably also with quail, water forms approximately 56 percent of the body weight and 72.5 percent of the contents of the egg and ranks far above any other substance in rate of turn-over in the body. A lapse of 24 hours without food will not appreciably check laying, but the same interval without water may cause complete cessation.

GRIT

Gallinaceous birds can digest whole grain without the aid of grit, but when it is present, less energy is required by the gizzard for grinding and there is a more efficient utilization of feed. It is well therefore to keep before the birds a supply of insoluble, nonfriable grit. Clean, sharp-edged quartz, the size of No. 8 shot, is good. If gravel grit is used, the fine particles may be sifted out for use in the dusting boxes. For grit the mature birds prefer gravel that will pass through a screen with $\frac{6}{64}$-inch openings, but not through a $\frac{5}{64}$-inch mesh. Particles of larger size are taken to some extent, but the waste increases proportionately. A bird may pick up a large particle, hold it in its mouth as it moves away from the grit hopper, and drop it through the wire flooring. If the waste is of no consequence, procedure can be simplified by feeding the gravel grits as they come, and letting the birds choose the size they want.

GREENS

Green leaves are good sources of several dietary factors, but if the birds receive a diet that contains optimum levels of essential vitamins, minerals, and amino acids, greens are not necessary. Under such conditions they would serve as a relish. Lawn clippings, freshly cut alfalfa, or bits of lettuce may be given twice a week or oftener.

BREEDING DIET

An all-mash breeding diet (see accompanying formula) should be kept before the birds at all times. No grain mixture is to be fed as a supplement, as it may unbalance the diet and cause a deficiency in certain vital nutrients.

ALL-MASH BREEDING DIET (26 PERCENT PROTEIN)

(To be fed one month before breeding season)

	Parts by weight
Yellow corn, ground	25.0
Wheat middlings, standard	10.0
Alfalfa leaf meal, dehydrated	10.0
Soybean oil meal, high-temperature processed	36.0
Buttermilk, dried	12.0
Bonemeal, special steamed	3.0
Limestone, high-calcium pulverized	2.5
Salt mixture	1.0
Vitamin A and D feeding oil fortified	.5
Total	100.0

Breeding birds should be started on the all-mash diet 1 month before the breeding season. The change to this from the maintenance diet (p. 39) should be made gradually over a period of at least 4 or 5 days by blending the two diets together.

The feeder shown in figure 8 (1) has proved most satisfactory for preventing waste of mash and grain. Even this feeder must not be more than three-fourths full. In fact, with a few refractory birds, half full is too much. On the other hand, although prevention of waste is desirable for economy's sake, the mash hoppers must not be allowed to become empty. The birds must have access at all times to a generous supply of egg-producing material.

INCUBATION

COMMERCIAL OPERATIONS

For commercial purposes the only practical way to hatch quail eggs is with an incubator. Any of those made for use with poultry can be used for quail. They will hold approximately from two to two and one-half times as many quail as chicken eggs. A few manufacturers provide special dividers for their trays to hold the eggs of game birds. A breeder can provide his own dividers, however, by forming trough-like egg holders from strips of ⅓-inch mesh hardware cloth, and tacking them side by side in the tray (fig. 10). According to experimental work done by Romanoff in New York State, quail eggs may be incubated and hatched in most of the properly constructed incubators of either still-air or agitated-air types, provided appropriate corrections are made for temperature and humidity based on the rate of air movement. The agitated-air type is apparently preferred. Likewise, a small incubator can be more successfully controlled than a large one for handling quail eggs. To maintain the humidity and temperature at the proper levels throughout the hatching period, a separate hatcher is helpful but not necessary. The shell of the quail egg is about one-third as thick as that of the chicken; therefore, strong air circulation is undesirable, as it will cause excessive evaporation.

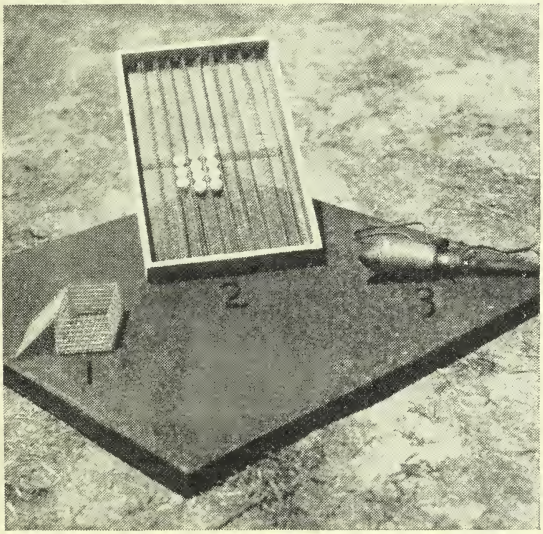

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***Figure* 10.—Equipment for incubation: 1, Pedigree basket; 2, tray with dividers of hardware cloth; 3, electric egg candler.**

MECHANICS OF INCUBATION

Because of the danger of disease infection, quail eggs should not be placed in the same incubator with those of chickens or turkeys. Before the eggs are set, they should be checked for soundness of shell, all those cracked being discarded, because they may leak in the incubator.

The eggs should be set vertically, with the larger end uppermost and with wads of newspaper packed at the end of each row to prevent shifting. As the rate of exchange of oxygen and carbon dioxide is in proportion to the size of the embryo, very little fresh air is needed at the beginning of incubation, but it should be increased to an abundant supply at hatching time. The operator should adjust the intake and exhaust openings so that they are about a fourth open during the first week, half open during the second week, three-fourths open through the fifteenth to the nineteenth days, and completely open thereafter. It may be necessary to modify this schedule, as various types of incubators may require a different adjustment of air supply, but in general it should be satisfactory.

Three to four daily turnings of the eggs are sufficient for 19 days, after which no turnings should be made. During this period the dry-bulb temperature reading in a still-air incubator, either hot-air or hot-water type, should be 103° F., and the wet-bulb reading should be 89° to 91°. In the agitated-air type, the reading of the dry bulb should be 99.5°, and the wet, 87° to 88°.

The extreme thinness and the white color of a quail egg make candling easy. Infertile eggs and dead embryos may be detected at the end of 1 week by the use of a spotlight candler (fig. 10) or of a flashlight. Infertile eggs show no signs of germ growth and have a clear appearance. Dead embryos are seen as a floating dark spot surrounded by a faint blood ring. Live germs fill about a third of the egg. A second candling may be made on the fourteenth day, when the living embryo will fill most of the egg, while the dead germ will fill only a portion and show a blood ring.

On the twentieth day the eggs are moved to the hatching compartment or to a separate hatcher. The trays should have covers (fig. 11), as newly hatched quails will escape if not confined, more usually being found at the bottom of the incubator than in the trays. During this period, the temperature in a still-air hatcher should be about 103.25° F., with the wet-bulb reading 91° to 93°. In an agitated-air type the temperature should be about 99.75°, and the wet-bulb reading should be 88° to 90°. At hatching time the ventilators should be wide open.

The breeder who wishes to keep pedigree records should on the twentieth day of incubation sort the eggs into pedigree baskets according to parentage. All the eggs of one female are kept together in one or more baskets. If there are only a few eggs from each of several females, those of two birds may be placed in one basket with a divider of hardware cloth between the lots. Commercial pedigree baskets for domestic chicken eggs are unnecessarily large for quail eggs. In figure 10 is shown a simple, effective, and economical pedigree basket made of ⅓-inch-mesh hardware cloth. A block of wood, 2 by 4 by 5 inches long, can be used as a mold. After the hardware cloth is cut, it is shaped around the block to form a basket. The corners and a lid are fastened in place with wire.

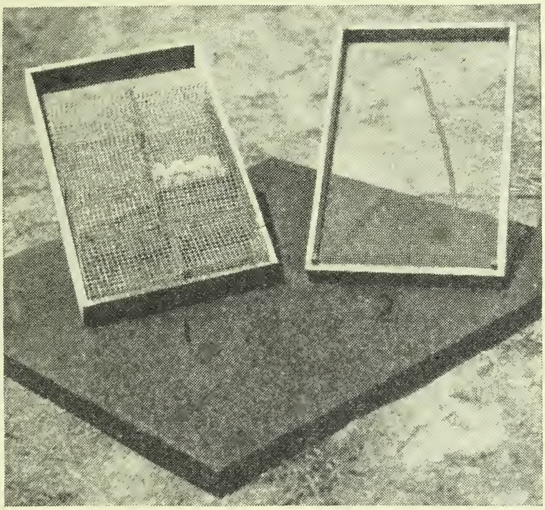

***Figure* 11.—1, Hatching tray with pedigree baskets in place; 2, cover of tray.**

Quail chicks hatch 22½ days after the eggs are set (fig. 12). Their escape from the shells is rapid, and the entire brood will normally be out in less than 4 hours. Because of malposition or excessive evaporation of moisture, some young quails have difficulty in hatching. With poultry, many breeders consider "helping out" as foolhardy, as most of the chicks so helped die soon afterward or else become unthrifty. With quails, however, the operation is more successful—it should be carried on in a warm room as gently as possible and the chicks quickly returned to the hatcher for 24 hours to be dried off without chilling.

All chicks should be left in the incubator or hatcher for about 24 hours after hatching, the humidity being reduced to permit quick drying. During the drying-off period no food and water are required. Nature has provided sustenance, however, with the remainder of the yolk of the egg from which each chick has developed. This provides food and moisture for the first 24 to 48 hours of the bird's life. Except under unusual conditions, as the feeding of a diet low in vitamin G to the parent birds, the yolk will be entirely assimilated at the end of the second day.

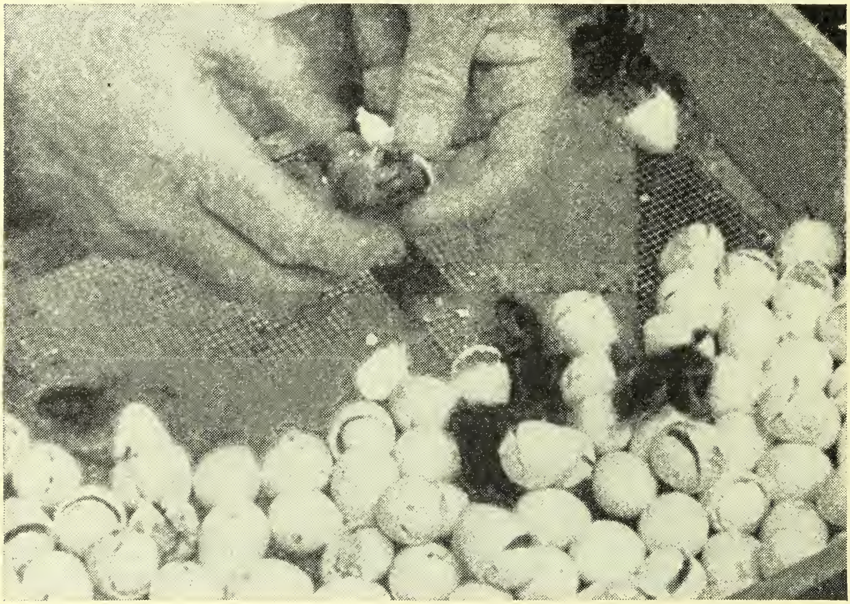

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Figure **12.—Quail chicks hatching.**

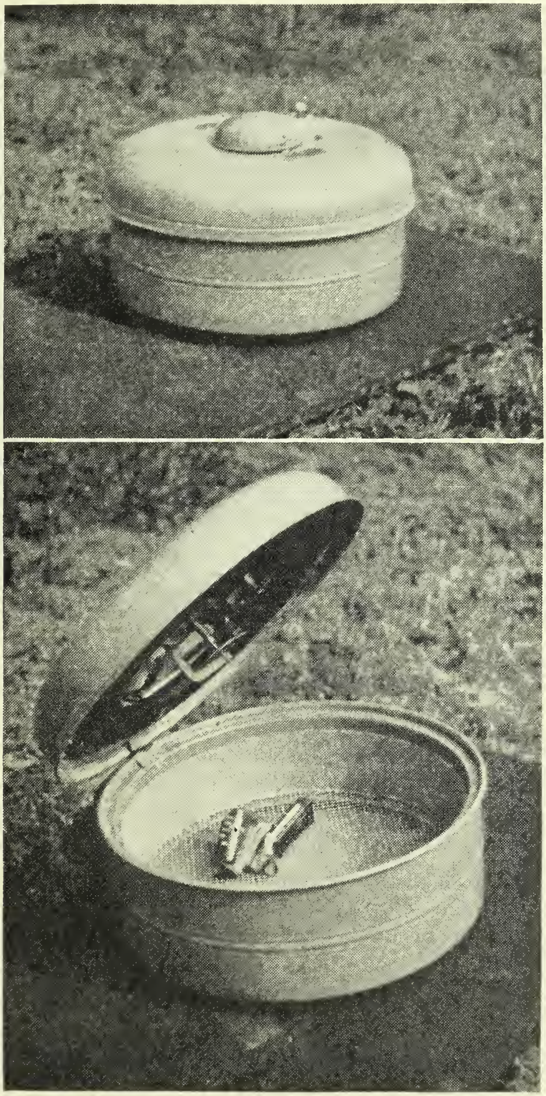
SMALL-SCALE OPERATIONS

In small-scale breeding with game birds the chicks may be hatched in midget incubators (fig. 13) or under bantam hens. Several manufacturers of poultry equipment produce inexpensive electric- and oil-heated incubators of small capacity that are efficient. An electric midget incubator, as illustrated, has a capacity of about 60 domestic hen eggs, or approximately 150 quail eggs, and can be purchased for about $15. The temperature control is automatic as in larger incubators. For about the same price an oil-heated midget incubator of 225-quail-egg capacity can be obtained.

Until artificial incubation and brooding were introduced for quails in 1929, bantam chickens were used exclusively for the purpose, and considering their limitations, they do a successful job although able to cover only 15 to 18 eggs.

MECHANICS OF INCUBATION

In selecting bantams one should look for birds with quiet, motherly temperaments. Silky, Cochin, and Brahma bantams fall in this category, but their full feathering, as in all poultry, provides harbors for mites and lice. Further, the leg feathers of Cochins or Brahmas when wet or muddy may interfere with the hen's efficiency as a brooder.



B41364; B41363

***Figure* 13.—Incubator, closed and open, 150-egg capacity, adequate for small-scale operations.**

For both setting and brooding, a Seabright or a crossbred ornamental bantam with Cochin blood is best. If a breed that has leg feathers must be used, it is advisable to clip these off. Use of a hen with scaly-leg disease also should be avoided.

A nest like that illustrated in figures 14 and 15 is ideal for bantam setting. Hardware cloth should be attached to the bottom to keep out mice and snakes. Both interior and exterior should be treated with a mite-repellent wood preservative at least a week before the eggs are set. The box is placed on the earth in a sheltered place, and the bottom is covered with loose soil or with a piece of inverted sod in which a shallow depression is made for the nest.

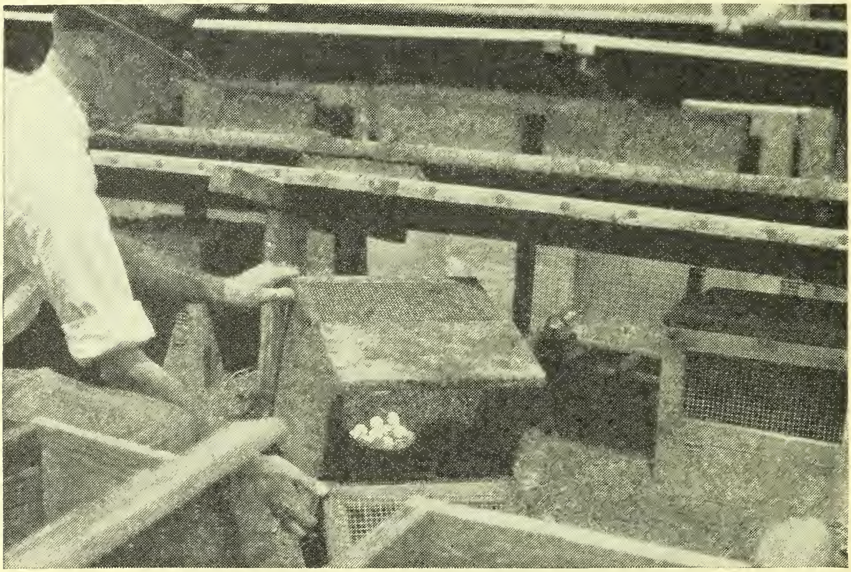


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***Figure* 14.—Hatching Boxes for use with bantams. (Photo courtesy of State Game Farm, Windsor Shades, Va.)**

During incubation mites are more likely to give trouble than lice. Since sodium fluoride does not kill mites, an additional dusting should be made with a strong insect powder, preferably one containing nicotine, at the beginning of incubation and again 10 days later. Should mites develop just before the eggs are due to hatch, the eggs and nesting material should be removed while the hen is feeding, the nest box disinfected with a cresol solution, and a new nest constructed before she is returned. The hen should not be dusted just prior to the egg hatching, as the insect powder will be harmful to the chicks. The presence of mites in the nest may be determined by the specks they leave on the eggs like those made by flies, or by a close examination of one's hand for mites after it has been held a few minutes in the nest.

The bantam should be confined to the nest constantly except once each morning, when she is released to feed, drink, and defecate. She should be returned to the nest at the expiration of half an hour, or sooner if the weather is cool or rainy.

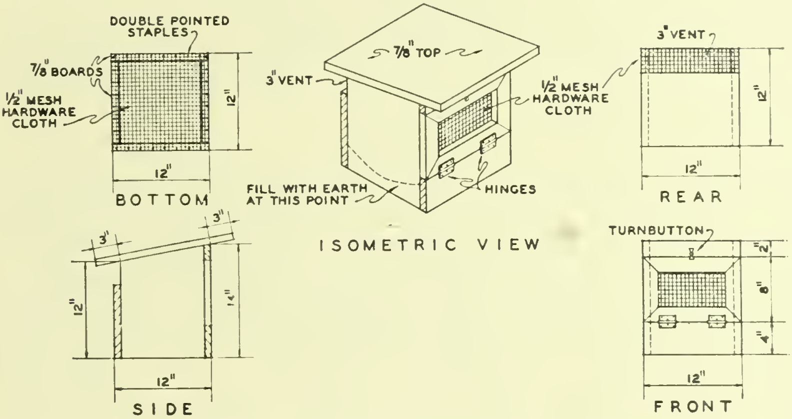

Figure **15.—Construction details of a hatching box.**

BROODING

PROBLEMS

The tiny creature that emerges from a quail egg on the twenty-second or twenty-third day of incubation with all its fluff is only about the size of the end of a man's thumb. Each chick weighs 1/4 to 1/5 ounce, and it would take 65 to 80 to weigh 1 pound. The first 4 weeks of a quail's life in captivity are the most critical. Many breeders consider a 45- to 50-percent loss at that time as normal. They feel that birds brought successfully through this period will suffer slight losses afterwards. The three major difficulties during the first 2 weeks are (1) brooder pneumonia, (2) intestinal disorders due to faulty nutrition or nutritional "entero-complex," and (3) cannibalism.[4]

BROODER PNEUMONIA

An acute and highly fatal respiratory disease of quail chicks, known as brooder pneumonia and also as quail rhinitis and snuffles, is similar to the common cold in man. Chicks sneeze and cough, hold the beak open, and show difficulty in breathing. Post-mortem examination reveals large quantities of mucus in the nasal passages and larynx, but the organism responsible is unknown. Losses may be high during a hot period or at times of pronounced changes in weather.

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[4] For a fuller discussion of diseases, see Farmers' Bulletin 1781, Diseases of Upland Game Birds, and Farmers' Bulletin 1652, Diseases and Parasites of Poultry, issued by the U. S. Department of Agriculture and obtainable from the Superintendent of Documents, Washington, D. C.—No. 1781 at 5 cents a copy; and No. 162 at 10 cents.

To minimize brooder pneumonia the breeder should take three precautions: (1) Avoid crowding the chicks; (2) maintain proper temperature in brooder; and (3) have sufficient ventilation, allowing 1 square foot or more of total pen space for every 3 chicks.

The brooder temperature should be checked several times daily. For the first week 96° to 97° F. is satisfactory. The temperature should be dropped 5 degrees each week. The thermostatic control must function properly.

The chicks should be closely observed. If they stand apart or crowd at a distance from the hover, panting and with wings raised from the body, they are too warm. Some may stand with drooping heads and closed eyes, or lie on their sides. On the other hand, if they crowd together under the hover or in a corner, they are cold. A plaintive chirp of distress may be heard in either case. Comfortable chicks will be found either actively eating, drinking, or running around the brooder, or squatting contentedly near the edge of the hover with their eyes closed. A cheerful murmur will be heard from the group.

Plenty of ventilation is essential to maintain proper humidity in the pen and to furnish the chicks with a constant source of oxygen. The correct ventilation must be determined according to the weather and the wind velocity—common sense rather than hard and fast rules must govern.

NUTRITIONAL ENTERO-COMPLEX

The term "entero-complex" has been used by Don Coburn, veterinarian at the Patuxent Research Refuge, to describe symptoms believed due to excessive quantities of fibre in the feed. Variations in the quantity determine the severity of the symptoms and the course of the disease, from impacted gizzards to enteritis, cecitis, and pasted vents. Bacterial invasions may follow the mechanical injury but, according to Coburn, in no instance was an infestation of protozoa or other animal forms found, and repeated tests, using tissues as well as cultures from the dead birds, failed to reproduce the disease in a single instance.

Further research is needed to determine whether this disorder, which is responsible for as much as 50 percent of the chick mortality in some flocks, is caused by the mechanical condition of the feed, the fiber content, a lack of some factor, or a combination of nutritional deficiencies. On the basis of the meager information now available, it is advisable not to use such highly fibrous material as ground whole oats in the diet for the chicks, and to have corn, hulled oats, and other grains ground to such fineness that no large flakes of the seed coats will be present.

The dietaries given on pages 12, 34, and 39 have been formulated with these requirements in mind. It is strongly recommended also that water warmed to about 80° F., or at room temperature, rather than cold water, be given the birds fresh every day in a clean receptacle. Finally, coarse sand should be kept before the birds always, from the moment they are transferred to the brooder. For the first 2 or 3 days it may be found desirable to sprinkle the sand in the mash, instead of supplying it in a separate receptacle, to prevent the birds from gorging themselves on it.

CANNIBALISM

Cannibalism, the plague of all game-bird breeders, is of sporadic outbreak. When or where it will appear cannot be foretold, but when it strikes it plays havoc unless prompt and determined effort is made to eradicate it. Picking at the toes, beak, head, wings, or vent and disemboweling are manifestations of the vice. Toe picking and beak picking, the two most commonly observed, may begin a few days after hatching.

Quails are sharp-eyed, and seem filled with curiosity. A bit of feed clinging to a toe or beak will start other chicks picking. Moist feeds, as clabber, semisolid buttermilk, and moist mash, besides being fly hazards, may be especially objectionable in this way. Powdery feeds, too, are undesirable, as dust from them cakes in a bird's nostrils, presenting an inviting object of attack. A toe-picked chick is usually so maimed and weakened from loss of blood that it cannot reach the feed and water containers, and finally dies of starvation. When beak-picked, a chick often has the entire upper mandible torn away, leaving it so severely handicapped for feeding that death by starvation results.

There is a marked relationship between cannibalism and the intensity of light in the brooder pens—the brighter the light the greater is the opportunity for cannibalism. At least one State game farm combats cannibalism by keeping the quail chicks in semidarkness during the brooding period. Rearing young pheasants in darkness has been successfully practiced for some time by certain New York State game farms. The birds are kept in total darkness except for feeding periods twice a day.

Overcrowding, overheating, chilling, or bad ventilation also may contribute toward cannibalism. All these unfavorable factors, however, may be eliminated by good management. One of the main causes for cannibalism may be a nutritional deficiency. Recent observations at the Patuxent Research Refuge show that an inadequate supply of common salt may be the cause. Outbreaks of this vice and fighting among adult birds during the winter of 1939–40 were almost immediately checked by raising the salt content of the diet to 2 percent (in one or two cases to 6 percent for several days). The growing and maintenance diets were then formulated on this finding.

When an outbreak of cannibalism occurs, the addition to the diet of 2 or 3 percent of salt should be tried for several days, or a thin layer of salt should be sprinkled once or twice on top of the feed in the hopper. If this fails, clip both mandibles of the beak of each bird with a pair of fingernail nippers, taking care to cut up to, but not into, the quick. The end of each mandible should be carefully rounded to prevent the beak from looking malformed when it grows out. If the vice reappears, repeat the clipping process. When possible, treat only the offenders. Keeping the birds in darkness for several days also will help.

HOUSING AND EQUIPMENT

COMMERCIAL OPERATIONS

Two general types of brooder houses, apartment and colony, are used by commercial quail breeders. The apartment type is similar to a long brooder house for poultry. It consists of a series of adjoining rooms each large enough inside for an attendant to work. In figures 16 and 17 two of the apartment-type houses are shown that conform in general yet differ radically in interior design, equipment, and management. The upper illustration shows a house that consists of 6 brooder rooms and a feed room. The greater part of each of the longer side walls is of glass. In each of the first 2 rooms are 12 pens, 4 next to each side wall, and 4 in the middle. In the remaining rooms pens are placed only next to the windows and there is access to wire-covered runs outside. Although the birds are kept off the ground, they are not on wire but run on a litter of crushed corncobs. All chicks are started in room 1, and the pens are then moved successively from one room to the next at intervals of a week. The temperature in room 1 is started at 98° F. and reduced a little each day until it reaches 90° F. on the seventh day. Then the temperature decreases by 5-degree steps from rooms 1 to 6.

The lower illustration (fig. 17) shows a brooder house that is divided into 10 compartments, 6 by 6 feet, each of which will accommodate 125 quail chicks. Windows are on one side only. The interior arrangement of the pens is very similar to that for poultry chicks. There is a large hover at the rear, and shredded cane litter is used over the entire

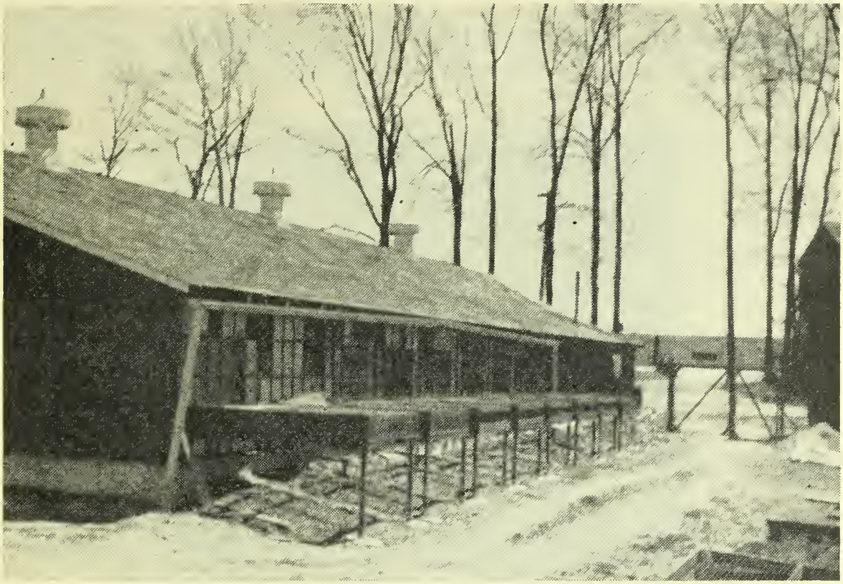

Figure 16.—Apartment-type brooder house, showing glass side walls and outside runs elevated above the ground. (Photo courtesy of Frank Hanna, Oxford, Pa.)

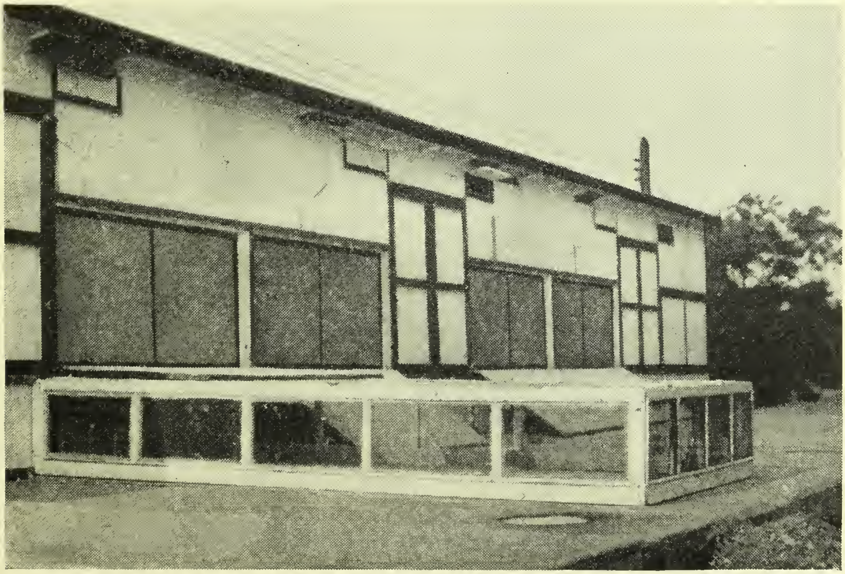

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Figure 17.—Apartment-type brooder house, showing screened, concrete-floor sun ranges. (Photo courtesy State Game Farm, Middle Island, N. Y.)

floor. After the first week the chicks are given access to screened, concrete sun ranges, where they run on sand. Puddles of cresol disinfectant, into which the service man must step before he can enter a compartment, are in front of each door. The temperature in the pens is reduced by 5° F. each week until at the end of 6 to 8 weeks the birds are moved to holding pens.

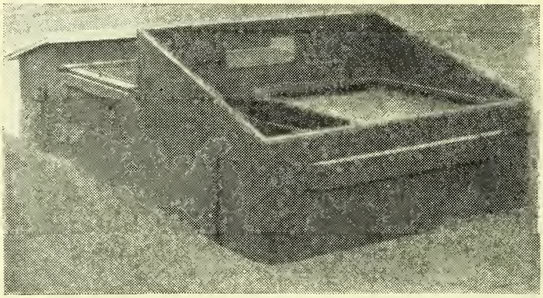
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***Figure* 18.—Colony brooding pen, with top removed to show heated and cool compartments.**

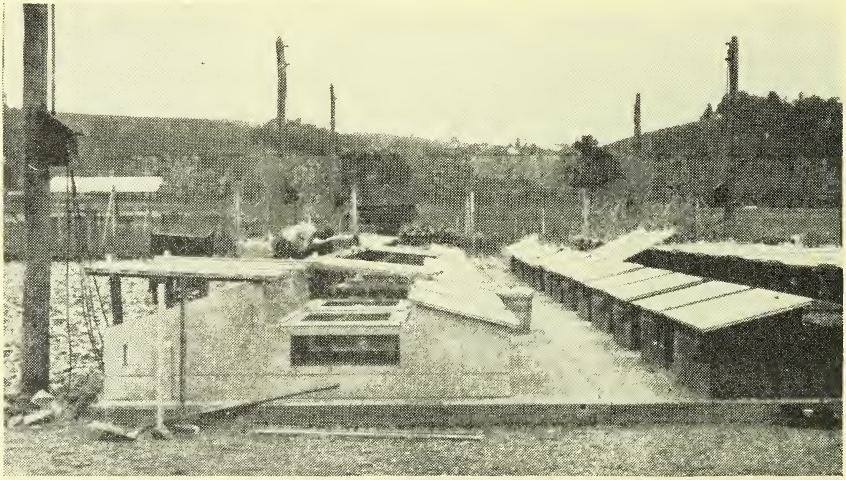
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***Figure* 19.—Colony brooding pens, in use at the State Game Farm, Loyalsock, Pa.**

The colony pen is used more extensively than the apartment-type, because it is easily made, is economical, and has proved satisfactory. There are two principal types. Figures 18 and 19 show one designed by Geo. S. McCarty, of Newfield, N. J., with a capacity of 40 chicks and used for quails of all ages. It stands close to the ground and has a shelter at each end and a sunning room covered with fly screening in the middle, the floor being of hardware cloth throughout. Every crack is stopped that might permit a fly or mosquito to enter. The brooder is kept in one of the shelters, and litter is packed under the heating unit to form an upward slope from the cool compartment to the back wall. There is a 10-degree change in temperature for every

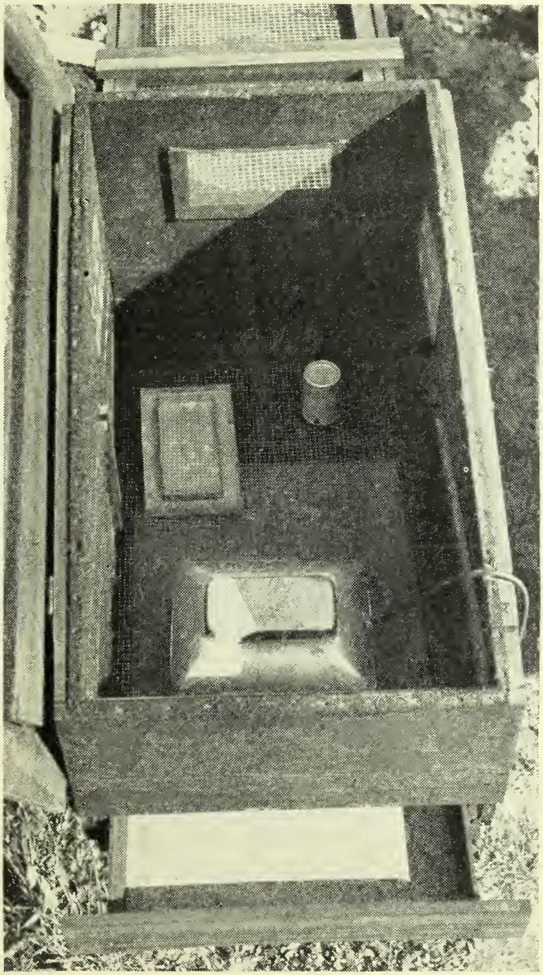
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Figure **20.—Colony brooding pen, project type, with top opened, showing hover, hopper, water fountain, and pan for droppings.**

inch of elevation on the slope under the hover, and the chicks thus may select a suitable temperature The shelter at the opposite end of the brooder is to protect the birds in time of storm after they have been given access to the middle room.

Many breeders run their chicks on litter. This practice may prove satisfactory if the material is changed every week, but the use of wire floors is more to be recommended, as on them there is less possibility of the chicks' picking up contamination.

Figures 20, 21, and 22 illustrate a type of brooder pen designed by the junior author from principles developed by Coleman. Thorough tests have proved it satisfactory, economical, and efficient. The maximum capacity is 40 chicks. The pen faces east and rests on two posts, 4 by 4 inches, about 30 inches above ground. The woodwork should be treated with a coal-tar or other preservative. The enclosed section consists of two compartments separated by a removable partition, and the heating compartment has a removable ceiling made of insulating board.

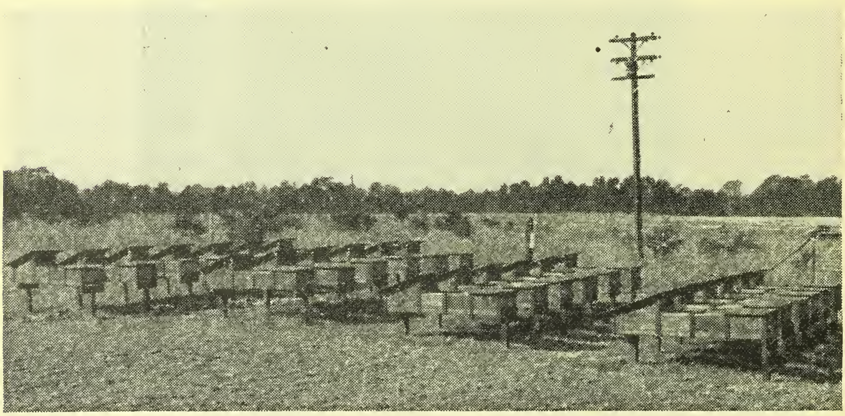

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***Figure* 21.—Arrangement of brooding pens in quail enclosure at the Patuxent Research Refuge.**

The sun range and all ventilators are covered with bronze fly screening. In addition, ½-inch-mesh wire cloth is used on the tops, sides, and front end of the run for reinforcement. The floor is of ⅓-inch-mesh hardware cloth. Galvanized-iron pans, one under the sun porch and one under the enclosed section, catch all droppings. A list of materials needed for one of these pens is given on page 28. The cost of construction, including labor, will run from $20 to $24.

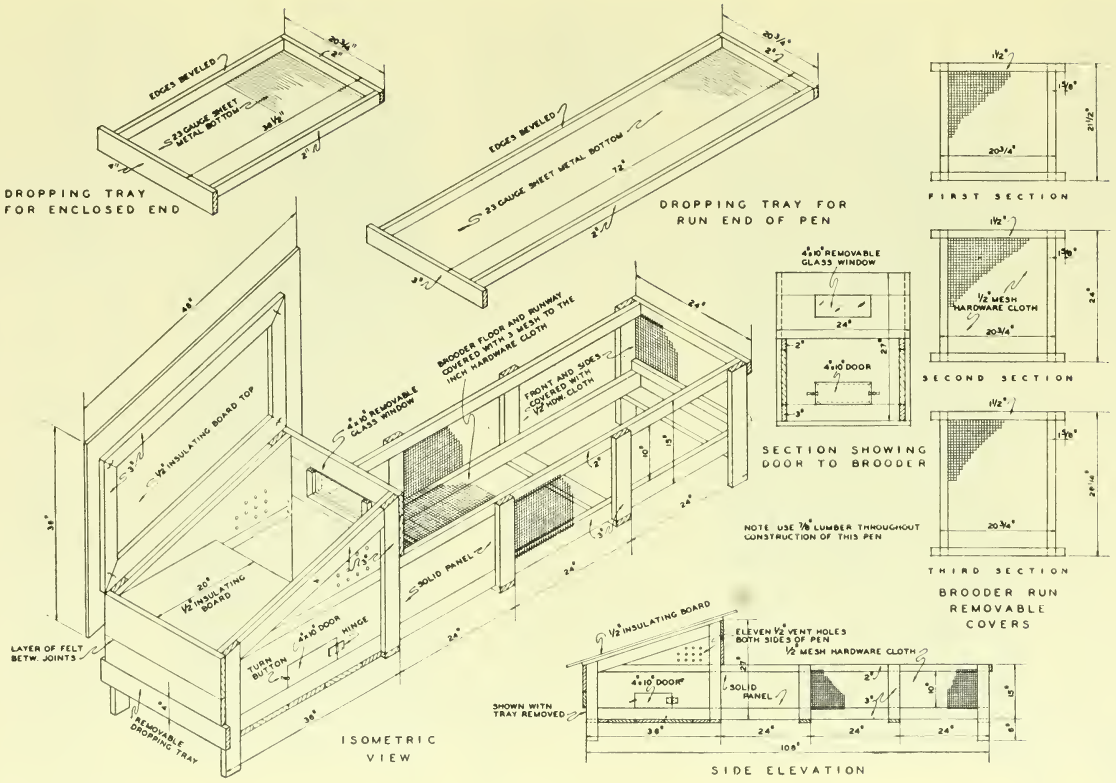
DROPPING TRAY FOR ENCLOSED END
EDGES BEVELED
23 GAUGE SHEET METAL BOTTOM
20¾"
2"
36½"
2"
4"
DROPPING TRAY FOR RUN END OF PEN
EDGES BEVELED
23 GAUGE SHEET METAL BOTTOM
20¾"
2"
72"
2"
3"
FIRST SECTION
SECOND SECTION
THIRD SECTION
1½"
1⅞"
21½"
24"
20¾"
½" MESH HARDWARE CLOTH
BROODER RUN REMOVABLE COVERS
4"×10" REMOVABLE GLASS WINDOW
24"
27"
2"
3"
4"×10" DOOR
SECTION SHOWING DOOR TO BROODER
NOTE USE ⅞" LUMBER THROUGHOUT CONSTRUCTION OF THIS PEN
48"
½" INSULATING BOARD TOP
3"
4"×10" REMOVABLE GLASS WINDOW
BROODER FLOOR AND RUNWAY COVERED WITH 3 MESH TO THE INCH HARDWARE CLOTH
FRONT AND SIDES COVERED WITH ½" HDW. CLOTH
24"
10"
15"
2"
3"
SOLID PANEL
20"
½" INSULATING BOARD
4"×10" DOOR
HINGE
TURN BUTTON
LAYER OF FELT BETW. JOINTS
REMOVABLE DROPPING TRAY
36"
ISOMETRIC VIEW
½" INSULATING BOARD
ELEVEN ½" VENT HOLES BOTH SIDES OF PEN
½" MESH HARDWARE CLOTH
4"×10" DOOR
SOLID PANEL
SHOWN WITH TRAY REMOVED
108"
SIDE ELEVATION
R8068M

Figure 22.—**Construction details of quail brooding pen shown in figure 20.**

BILL OF MATERIALS FOR QUAIL BROODING PEN

- Lumber (⅞-inch material when not otherwise specified):
  - Frame:
    - 2 pieces, 3 by 108 inches.
    - 2 pieces, 2 by 108 inches.
  - Shelter:
    - 2 pieces, 6 by 24 inches, for back.
    - 2 pieces, 6 by 24 inches, for front (door 4 by 10 inches cut from lower 6-inch piece).
    - 2 pieces, 6 by 20½ inches, for front (door 4 by 10 inches cut from lower 6-inch piece).
    - 2 pieces, 10 by 60 inches, for side (door 4 by 10 inches cut from right side only).
    - 2 pieces, 6 by 36 inches, for side.
    - 2 pieces, 3 by 36 inches, for side.
    - 6 pieces, 6 by 22¼ inches, for floor.
    - 2 pieces, 3 by 24 inches, for top.
    - 2 pieces, 3 by 36 inches, for top.
    - 1 piece, 4 by 26 inches, for tray for droppings.
    - 1 piece, 2 by 20¾ inches, for dropping tray.
    - 2 pieces, 2 by 36 inches, for dropping tray.
  - Uprights:
    - 4 pieces, 3 by 15 inches.
    - 4 pieces, 3 by 21 inches.
    - 2 pieces, 3 by 27 inches.
  - Run:
    - 3 pieces, 3 by 24 inches, for braces.
    - 1 piece, 2 by 24 inches, for brace.
    - 1 piece, 3 by 26 inches, for dropping tray.
    - 1 piece, 2 by 20¾ inches, for dropping tray.
    - 2 pieces, 2 by 72 inches, for dropping tray.
    - 2 pieces, 1½ by 22⅜ inches, for cover (first section).
    - 2 pieces, 1½ by 21½ inches, for cover (first section).
    - 2 pieces, 1½ by 22⅜ inches, for cover (second section).
    - 2 pieces, 1½ by 24 inches, for cover (second section).

- Lumber—Continued.
  - Run—Continued.
    - 2 pieces, 1½ by 22⅜ inches, for cover (third section).
    - 2 pieces, 1½ by 26¼ inches, for cover (third section).
- Hardware cloth:
  - Run (½-inch mesh):
    - 2 pieces, 12 by 48 inches, for side.
    - 1 piece, 12 by 24 inches, for end.
    - 1 piece, 20¾ by 21½ inches, for cover (first section).
    - 1 piece, 20¾ by 24 inches, for cover (second section).
    - 1 piece, 20¾ by 26¼ inches, for cover (third section).
- Bronze fly screening:
  - (16 mesh, for run):
    - 2 pieces, 12 by 48 inches, for side.
    - 1 piece, 12 by 24 inches, for end.
    - 1 piece, 20¾ by 21½ inches, for cover (first section).
    - 1 piece, 20¾ by 24 inches, for cover (second section).
    - 1 piece, 20¾ by 26¼ inches, for cover (third section).
  - Floor (⅓-inch mesh):
    - 1 piece, 22¼ by 108 inches.
- Miscellaneous:
  - Shelter:
    - 4 turn buttons, 2 inch, for front.
    - 1 turn button, 2 inch, for side.
    - 1 steel butt, 2 inch, for side.
    - 2 steel butts, 2 inch, for top.
    - 1 piece insulating board, ½ inch, 36 by 48 inches, for top.
    - 1 piece sheet metal, 23-gauge, 20¾ by 36½ inches, for dropping tray.
  - Hover:
    - 1 piece insulating board, ½ inch, 20 by 20½ inches.
  - Run:
    - 1 piece sheet metal, 23-gauge, 20¾ by 72 inches, for dropping tray.

Two kinds of electric hovers are shown in figures 23 and 24. The upper illustration shows one designed especially for quails. It has a humidifier at the top with a special replaceable heating unit below. For the colony brooder pen just described a 100-watt unit is necessary.

Figure 24 shows a home-made apparatus consisting of a tin cake pan, a circle of ⅓-inch-mesh hardware cloth, an electric socket and cord, and a 100-watt ruby bulb.

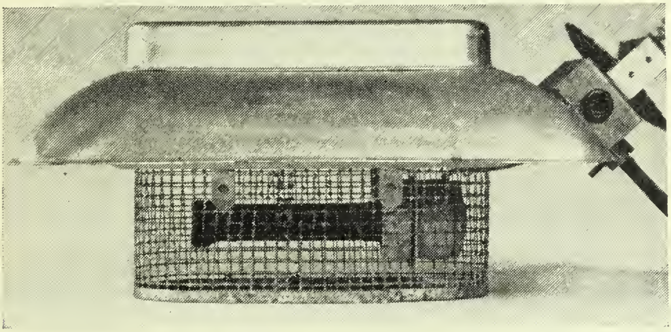

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***Figure* 23.—Electric hover of 40-chick capacity, designed especially for bobwhites.**

Figures 25 and 26 show a kerosene hover that is also satisfactory for quail brooding. It will run a week on one fueling.

Other equipment needed for quail brooding is shown in figure 27. Both the grit container and the base of the water fountain may be ordinary glass coasters as illustrated. A soup can, approximately 2¾ inches in diameter by 4 inches high, makes an excellent water reservoir for the fountain. A used can is satisfactory, provided it is not rusty and has a smooth blunt edge on the open end. A notch should be made on the edge of the open end, and the interior and exterior of the can should be coated with aluminum paint. It should be thoroughly dry before being used.

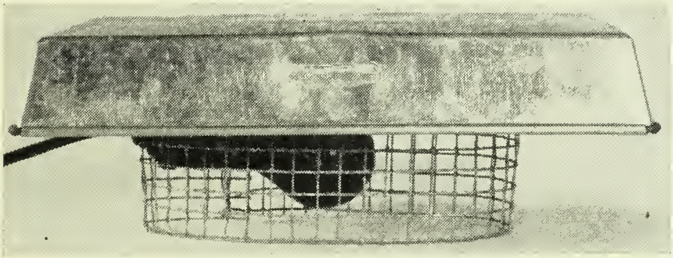

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***Figure* 24.—Home-made electric hover.**

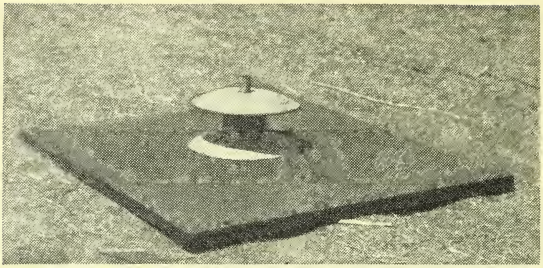

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Figure 25.—Kerosene hover that will run for a week on one fueling.

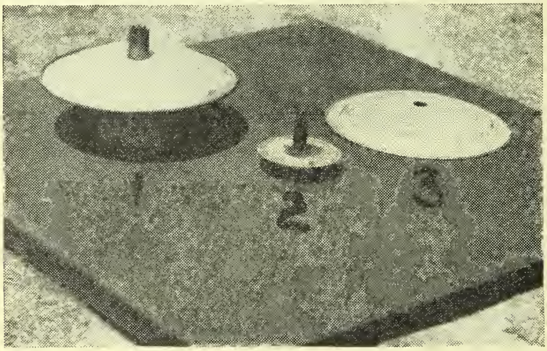

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Figure 26.—Kerosene hover shown in figure 25, disassembled: 1, Canopy and chimney; 2, wick holder; 3, oil reservoir.

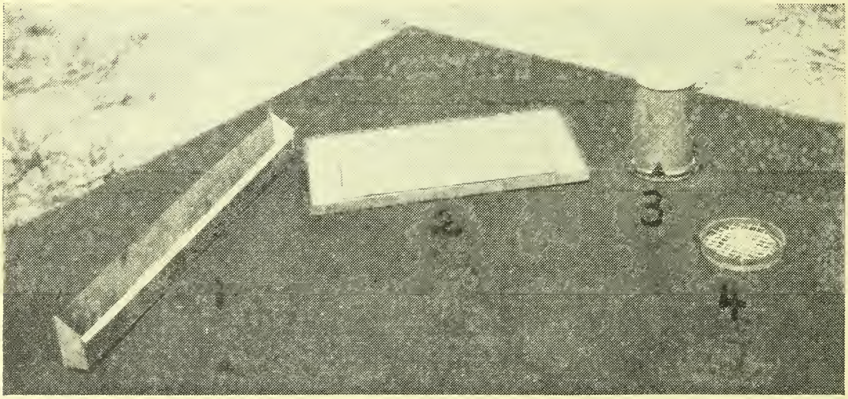

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Figure 27.—Equipment for brooding pen: 1, Hopper for use after fifth day, 18 by 1 by 1 inch high in front; 2, hopper for use during first 5 days, 4 by 9 inches with 3/4-inch sides, placed inside waste pan, 6½ by 11½ inches with 3/4-inch sides; 3, water fountain, consisting of glass coaster and soup can 2¾ inches in diameter; 4, glass coaster with mesh guard, for sand.

The feeder to be used for the first 5 days is a home-made galvanized-iron pan, 4 by 9 inches, with a ¾-inch ledge on all four sides. It is not necessary to solder the corners if care is taken in cutting and bending the metal. After the second day a 3½- by 8½-inch piece of ⅓-inch hardware cloth may be placed on top of the feed in this hopper to lessen waste. Likewise, as an additional precaution, a larger pan may be placed under the feed pan, as shown in figure 27. From the fifth day through the fourth week the chicks are fed from a wall feeder. When not kept too full, this container is a conserver of feed.

SMALL-SCALE OPERATIONS

The simplest brooder outfit that a small-scale breeder can use is the one shown in figure 28. The bantam mother that hatched the quail chicks is kept to rear them. To aid in disease control, however, it is advisable to keep hen and chicks on wire off the ground. A combination shelter and sun range similar to that shown in figures 20, 21, and 22, but without the movable partition and ceiling in the shelter, can be used for rearing with bantams. The feeding and watering equipment may be the same.

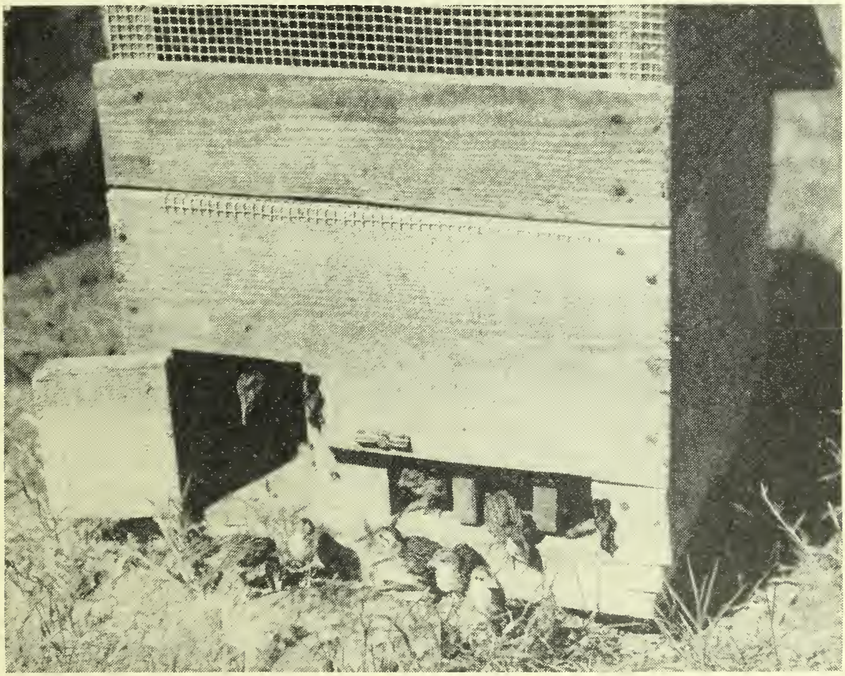

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Figure **28.—Brooding quail chicks with a bantam hen.**

CARE OF THE YOUNG

COMMERCIAL OPERATIONS

Before the quail chicks are removed from the incubator, the brooding equipment should be thoroughly cleaned and disinfected with a cresol compound and allowed to dry before being used.

A cool temperature or a draft in the room should be avoided at the time the chicks are removed from the incubator. Containers for holding and conveying the birds to the brooders should be close at hand. Cardboard crates, as manufactured for poultry chicks and having a thin layer of excelsior on the bottom, are very good.

Breeders who wish to keep pedigree records will find that numbered leg bands of celluloid, as used for canaries, will aid in identification. These bands may be attached at hatching time without difficulty, but they must be replaced with adult-size aluminum bands at the end of 3 weeks, or sooner if necessary, to prevent crippling by the tightening bands.

Either of two procedures may be followed during the first week of brooding. Of these, the first is the safer, especially during adverse weather, but it requires more equipment and thus involves a greater initial expenditure. In this procedure the birds are kept in a large room where the temperature ranges between 70° and 80° F. Commercial battery brooders, as pictured in figure 29, are used successfully. The temperature in the heating element at the rear of each compartment should be between 96° and 98° F., according to thermometer readings taken close to the floor. At first the chicks should be placed back of the curtain so that they will learn the source of the heat. Later they will select the temperature best suited to their individual needs by moving back and forth between the heated section at the rear and the unheated part in front. At the end of 2 weeks the birds should be moved to the colony brooders.

Under the second procedure the chicks are moved directly to the colony brooder. For the first 24 hours they are confined in the rear compartment and supplied with feed and water. On the second day the movable partition is raised and fastened above the opening between the two compartments, in such way that the birds cannot roost above the ceiling. On the third day, if the weather is fair, the birds are given access to the sun range. Except at night and during storms the porch should be available to the birds. Care must be taken, however, to shut them in at night and during bad weather. Unless the wind is high or very cool weather prevails, the front ventilator should be left open. The temperature for the first week should be about 97° F. and this should be reduced 5 degrees each succeeding week.

At the end of 5 weeks, if the weather is warm and clear, the birds may be moved to holding pens. In case of adverse weather, however, they should be kept in the brooder pen for another week.

Clean out the dropping trays once a week. A wall scraper with a 4-inch blade is a satisfactory tool for this purpose.

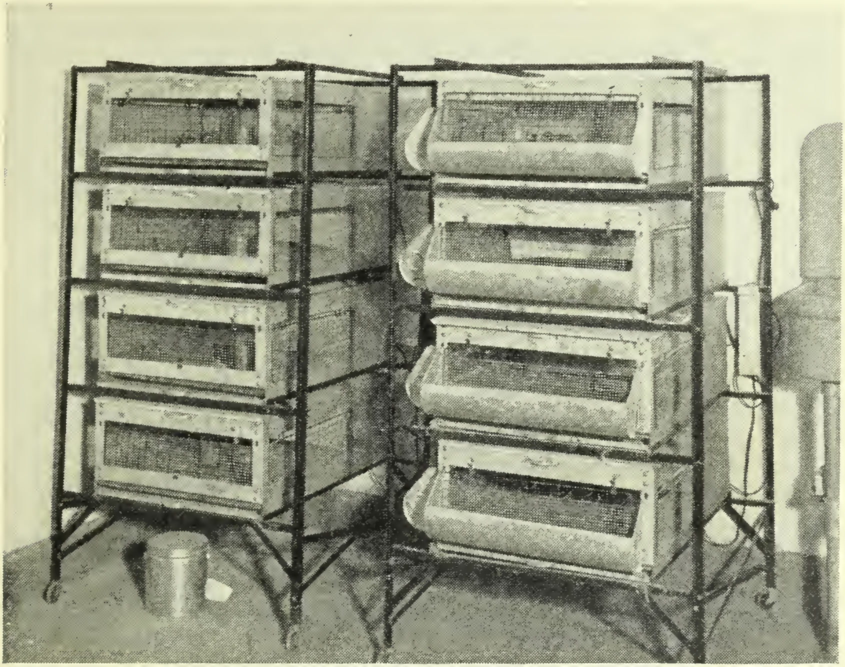

Figure **29.—Battery brooders for bobwhites. At left, for chicks during their first 4 weeks; hoppers and water fountains are inside. At right, for birds more than 4 weeks old, with feeding and watering equipment standard for poultry chicks. These compartments may also be used for mature quails during the remainder of the year.**

SMALL-SCALE OPERATIONS

The bantam hen is confined to the shelter for the duration of the brooding period, about 5 weeks, with feed and water for both chicks and hen in the shelter. The excrement is removed twice a week.

GROWING DIET

An all-mash growing diet (see accompanying formula) is kept constantly before the birds from the time they leave the incubator through the twelfth week.

ALL-MASH GROWING DIET (28 PERCENT PROTEIN)

(To be fed from hatching time to end of 12 weeks)

	Parts by weight
Yellow corn, finely ground	24.0
Millet, ground	10.0
Alfalfa leaf meal, dehydrated	5.0
Soybean oil meal, high-temperature processed	42.0
Buttermilk, dried	16.0
Bonemeal, special steamed	0.9
Limestone, high-calcium pulverized	0.9
Salt mixture	1.0
Vitamin A and D feeding oil fortified	0.3
Total	100.1

At the beginning of the sixth week the simplified maintenance ration (p. 39) is fed with the growing ration but in a separate container, thus giving the birds a choice. No supplementary grains should be used with this diet. Clean, fresh, warm water should be provided daily. From the time of the first meal the birds should be furnished with coarse sand in a coaster, the supply being replenished regularly. Although no other feeds are necessary, a small quantity of finely cut fresh alfalfa, chickweed, clover, or lettuce, fed daily in a separate container, will add relish to the diet. The quantity of feed required to raise a quail to the age of 10 weeks is about 2½ pounds.

Quail chicks as a rule do not have much trouble in learning to eat. A few seem helpless and apparently die of starvation, but the curiosity and pecking instinct of the majority quickly help them to get food. The breeder might devote a little time the first day, however, to assisting his tiny wards to learn this essential. Sometimes sprinkling pinches of feed, from a height of 3 to 4 inches, on top of that in the hopper will attract the birds' attention and start them actively picking. Particles of green leaves, either floating in the drinking water or lying on top of the feed, also will help. For the first couple of days some breeders mix hard-boiled eggs with the mash or plain rolled oats to form a moist, crumbly mass and give it either separately or on top of the dry feed. It is believed to be more palatable to the birds than dry mash and therefore more readily eaten. No more should be fed, however, than the birds will clean up within a space of 2 hours, for such feed lying around may become sour or moldy and cause trouble.

HOLDING DURING WINTER

DANGERS AT TIME OF CHANGE

A second crucial period in the lives of captive quails is that following their removal from brooders to holding pens. Dangers especially threatening half-grown birds are shock from chilling and infection with ulcerative enteritis.

Shock from chilling results when a breeder subjects his birds to a radical change in temperature. If cool or inclement weather prevails, it would be better to hold the young a week or two longer in the brooder pens than to run the risk of loss by moving too hastily. The birds should be shut up in the enclosed section of the holding pens for everal days after the change.

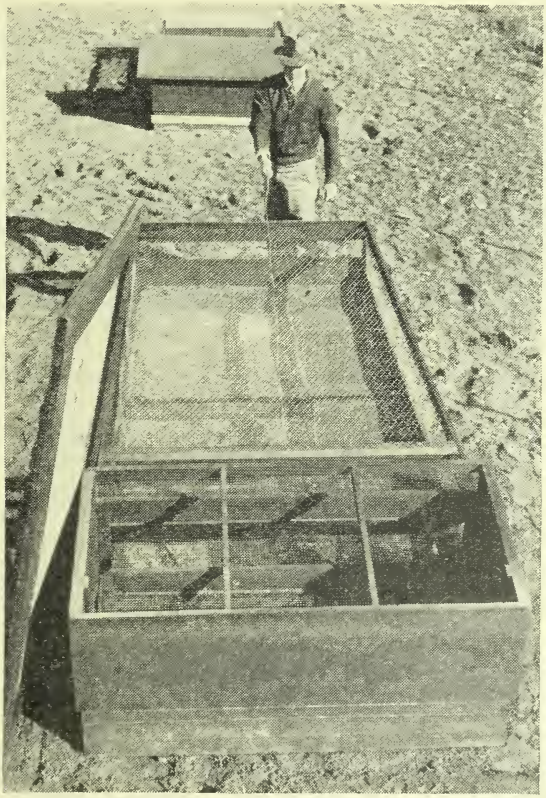

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***Figure* 30.—Holding pens, 40-bird capacity, for adult quails in winter, with top removed, showing method of closing front exit.**

Ulcerative enteritis, which appears at about changing time, is highly destructive to quails and probably is the most difficult avian infection with which the breeder has to cope. The infection is spread by contact with the droppings or by contamination carried by attendants or flies. It may be prevented by proper sanitary measures. The birds should be kept away from their droppings and from contaminated soil by penning them on hardware cloth off the ground (figs. 30, 31, and 32). They should not be near ordinary farm stock, especially domestic birds. It may be found necessary to cover all pen openings with bronze fly screening. This is advisable, however, only where birds are close to a source of contamination.

Care must be taken not to add new birds to a penned group, as fighting will be almost inevitable. If rearrangement must be made, all the birds should be confined to the shelter for several days afterwards, with the front ventilator darkened. If cannibalism occurs, the procedure suggested in the section under Brooding (p. 21) should be followed.

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Figure **31.—Arrangement of holding pens at the Patuxent Research Refuge.**

HOUSING AND EQUIPMENT

Figures 30, 31, and 32 illustrate satisfactory holding pens that will hold 40 birds each. The woodwork in them should be treated with a preservative. For hot summer days a piece of roofing may be tacked over the top of the sun range at the end away from the shelter to furnish shade. A list of materials needed to construct this pen is given on page 38. The approximate cost, including labor, is $20.

Where severe snow and sleet storms prevail, it may be necessary to brace the wire top of the sun range with two 2-inch supports extending from one side to the other, beneath the netting. They should be evenly spaced both from each other and from each end of the range. If vertical pieces are used with the horizontal ones, even greater strength will be given to the wire top. This type of construction should be avoided where possible, as quails become panicky when alarmed and fly against the top of the pen, and even against flexible poultry wire they often incur severe head wounds. Horizontal supports would thus present an even greater menace to the birds.

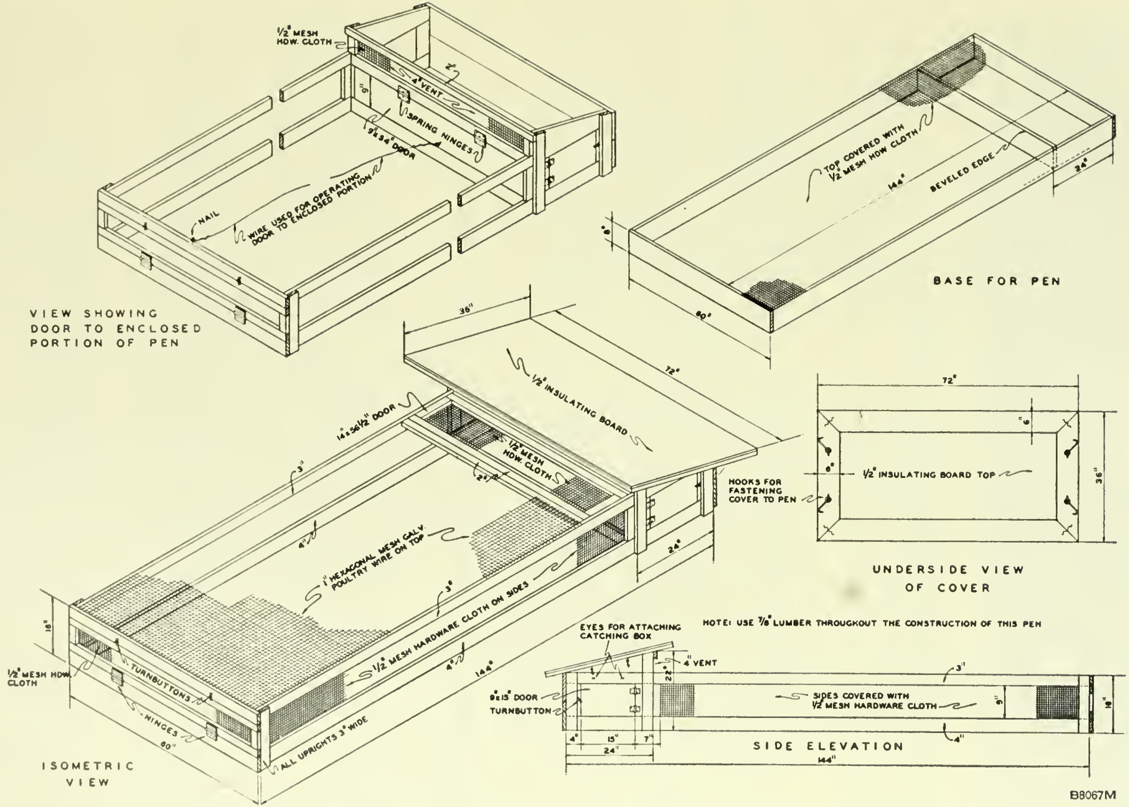
1/2" MESH HDW. CLOTH
2"
4" VENT
9"
SPRING HINGES
9"x34" DOOR
WIRE USED FOR OPERATING DOOR TO ENCLOSED PORTION
NAIL
VIEW SHOWING DOOR TO ENCLOSED PORTION OF PEN
TOP COVERED WITH 1/2" MESH HDW CLOTH
144"
BEVELED EDGE
24"
6"
60"
BASE FOR PEN
36"
72"
1/2" INSULATING BOARD
14"x56 1/2" DOOR
1/2" MESH HDW. CLOTH
2"
3"
4"
1" HEXAGONAL MESH GALV. POULTRY WIRE ON TOP
3"
1/2" MESH HARDWARE CLOTH ON SIDES
24"
18"
1/2" MESH HDW CLOTH
TURNBUTTONS
HINGES
60"
4"
144"
ALL UPRIGHTS 3" WIDE
ISOMETRIC VIEW
72"
6"
6"
1/2" INSULATING BOARD TOP
36"
HOOKS FOR FASTENING COVER TO PEN
UNDERSIDE VIEW OF COVER
NOTE: USE 7/8" LUMBER THROUGHOUT THE CONSTRUCTION OF THIS PEN
EYES FOR ATTACHING CATCHING BOX
4" VENT
22"
3"
9"x15" DOOR
TURNBUTTON
SIDES COVERED WITH 1/2" MESH HARDWARE CLOTH
9"
18"
4"
4"
15"
7"
24"
SIDE ELEVATION
144"
B8067M

Figure 32.—Construction details of holding pen shown in figure 30.

BILL OF MATERIALS FOR QUAIL HOLDING PEN

- Lumber (⅞-inch material when not otherwise specified):
  - Frame:
    - 2 pieces, 4 by 144 inches.
    - 2 pieces, 3 by 144 inches.
    - 1 piece, 4 by 60 inches.
    - 1 piece, 3 by 60 inches.
    - 1 piece, 4 by 56½ inches.
    - 1 piece, 3 by 56½ inches.
    - 1 piece, 3 by 60 inches.
  - Shelter:
    - 2 pieces, 8 by 60 inches, for back.
    - 2 pieces, 6 by 24 inches, for side.
    - 2 pieces, 7 by 9 inches, for side.
    - 2 pieces, 4 by 9 inches, for side.
    - 2 pieces, 9 by 15 inches, for door (small).
    - 1 piece, 9 by 54 inches, for door (large).
    - 2 pieces, 6 by 36 inches, for top.
    - 2 pieces, 6 by 72 inches, for top.
  - Uprights:
    - 4 pieces, 3 by 16 inches.
    - 2 pieces, 3 by 22 inches.
  - Run:
    - 2 pieces, 2 by 60 inches, for door (end).
    - 2 pieces, 2 by 5 inches, for door (end).
    - 2 pieces 2 by 56½ inches, for door (top).
    - 2 pieces, 2 by 10 inches, for door (top).
- Lumber—Continued.
  - Base:
    - 2 pieces, 8 by 144 inches.
    - 2 pieces, 8 by 60 inches.
    - 1 piece, 8 by 58¼ inches.
- Hardware cloth (½-inch mesh):
  - Shelter:
    - 1 piece, 6 by 60 inches, for vent.
  - Run:
    - 1 piece, 9 by 60 inches, for door (end)
    - 1 piece, 14 by 56½ inches, for door (top).
  - Base:
    - 1 piece, 60 by 144 inches.
- Miscellaneous:
  - Shelter:
    - 4 steel butts, 2 inch, for door (small).
    - 2 turn buttons, 2 inch, for door (small).
    - 2 spring hinges, for door (large).
    - 4 hooks and eyes, for top.
    - 1 piece insulating board, ½ inch, 36 by 72 inches, for top.
  - Run:
    - 2 steel butts, 2 inch, for door (end).
    - 2 turn buttons, 2 inch, for door (end).
    - 1 piece hexagonal-mesh poultry wire, 1 inch, 60 by 104 inches, for top.

Equipment for the holding pens is shown in figure 33. The water fountain is the same as that shown in figure 8. The hopper (fig. 33) is 18 by 2 by 2½ inches high in front. The grid above the feed, and the lip on the front edge help to prevent waste. The round chick feeder (fig. 33) makes an excellent grit container for mature birds. During freezing weather a heater should be provided for the fountain so that water will be available at all times. Tests of the kerosene heater illustrated in figure 33 have shown that it functions satisfactorily when placed in a box with the water container directly on top of it. As the dusting box can be dispensed with in winter, it may be used to hold the heater and fountain.

CARE OF NONBREEDING STOCK

Management in winter is simple. Feed and fresh water should be kept before the birds at all times, and the droppings should be cleaned out from under the pens about once a month. Except in the South, and even there during abnormally cold spells, the birds should be shut in their shelters at night. The operator should drive them in at

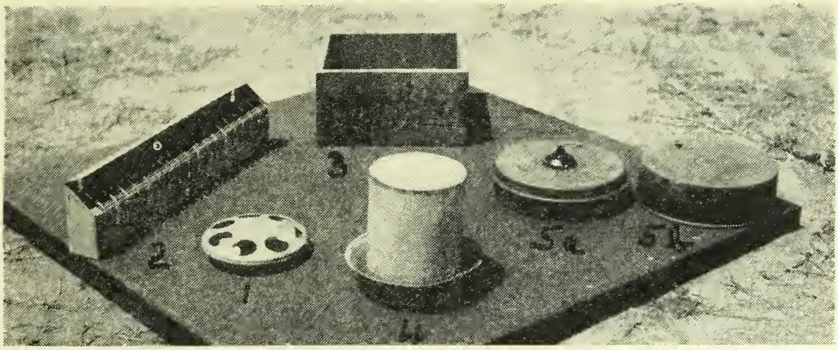

***Figure* 33.—Equipment for holding pen: *1*, Chick feeder, 6 inches in diameter with removable top, for grit; 2, wall feeder, 2⅛ by 18 by 5 inches high, with grid to prevent waste; *3*, dust box (fig. 9); *4*, water fountain, 5 inches in diameter, 2-quart capacity; 5, kerosene water heater, disassembled to show (*a*) reservoir and wick and (*b*) cover.**

least an hour before sunset, as they are hard to manage after they have settled for the night. Likewise, during any severe weather, they should be penned up for protection.

As the mating season approaches, bobwhites become restless and frequently fight in the holding pens. Then is the time to dispose of all stock except breeders, which should be paired off arbitrarily and placed in the breeding pens. If the members of a pair prove incompatible, they will fight, and a change of mates must be made. A few birds should be kept on hand for replacements, therefore, in case of mismating or because of deaths among the breeders. Male reserve stock in a holding pen should be separated from the females.

MAINTENANCE DIET

The accompanying formula gives a simplified maintenance diet that has proved satisfactory in experiments carried on at the Patuxent Research Refuge. In fact, the birds on this ration appeared in better flesh and feathering than did those on more complex feeds.

ALL-MASH MAINTENANCE DIET (12 PERCENT PROTEIN)

(To be fed in connection with the growing diet from the beginning of the sixth week; fed alone after the twelfth week, and to be changed to breeding diet 1 month before breeding season)

	Parts by weight
Yellow corn, ground	85.6
Alfalfa leaf meal, dehydrated	5.0
Soybean oil meal, high-temperature processed	7.0
Bonemeal, special steamed	1.2
Salt mixture	1.0
Vitamin A and D feeding oil fortified	0.2
Total	100.0

As noted in the section on brooding, this diet should be fed in conjunction with the all-mash growing diet from the sixth through the twelfth week. From the beginning of the thirteenth week until 1 month before the breeding season only the maintenance diet should be fed. No supplementary grains need be given. The grit should be that recommended for breeding birds.

CORRECTING DEFICIENCIES IN THE DIET

In using the breeding, growing, and maintenance diets recommended on pages 12, 34, and 39, it is to be taken into consideration that in certain sections the soil, and consequently the grains and other crops thereon, may be deficient in iron, iodine, or copper, all of which are important in quail nutrition. Where these deficiencies are suspected, the use of one of the following salt mixtures is suggested to supplement the diet:

SALT MIXTURE NO. 1

(Without iodine)

	Pounds
Common salt (NaCl)	50.000
Anhydrous manganous sulfate ($MnSO_4$)	.850
Anhydrous ferrous sulfate ($FeSO_4$)	.550
Anhydrous copper sulfate ($CuSO_4$)	.020
	51.420

SALT MIXTURE NO. 2

(With iodine)

	Pounds
Mixture No. 1	51.420
Potassium iodide (KI)	.035
Anhydrous sodium thiosulfate ($Na_2S_2O_3$)	.032
Calcium carbonate ($CaCO_3$)	.035
	51.522

It is especially important with either mixture that the supplements be weighed out accurately and thoroughly pulverized by a druggist or chemist and then carefully mixed with the common salt. As many druggists probably would not keep certain of these ingredients on hand, it might be desirable to purchase 1 or 2 pounds of each from a wholesale house. Substitutes for the chemicals recommended should not be accepted for either formula.

Manganese is necessary for the prevention of perosis, or slipped tendon, a leg deformity resulting from a nutritional deficiency. Be sure, however, that the manganese is mixed carefully with common salt. In mixing a 50-pound lot, spread about 10 pounds of common salt on the bottom of a clean dry washtub, sprinkle 0.85 pound of powdered anhydrous manganous sulfate evenly over the surface, and mix thoroughly. Add this mixture to the remaining 40 pounds of salt, again mixing thoroughly, either with the hands or with a paddle. Stored in a dry place, this mixture will keep indefinitely, though high humidity may cause lumps, which should be broken down by being forced through a sieve.

The sodium and calcium compounds are used in mixture No. 2 to stabilize the iodine. They should be mixed with the potassium iodide before the latter is combined with the other chemicals.

All three of these diets call for vitamin A and D feeding oil fortified, which is at least four times as potent in these vitamins as is ordinary cod-liver oil. It should meet all the specifications for U. S. P. cod-liver oil except that each gram shall contain not less than 400 international units of vitamin D and not less than 3,000 international units of vitamin A. To have the oil evenly distributed throughout the feed, first mix it with a part of the ground corn or with about 5 percent of the entire ration. Remove all lumps. Combine the resulting mixture with the bulk of the ingredients.

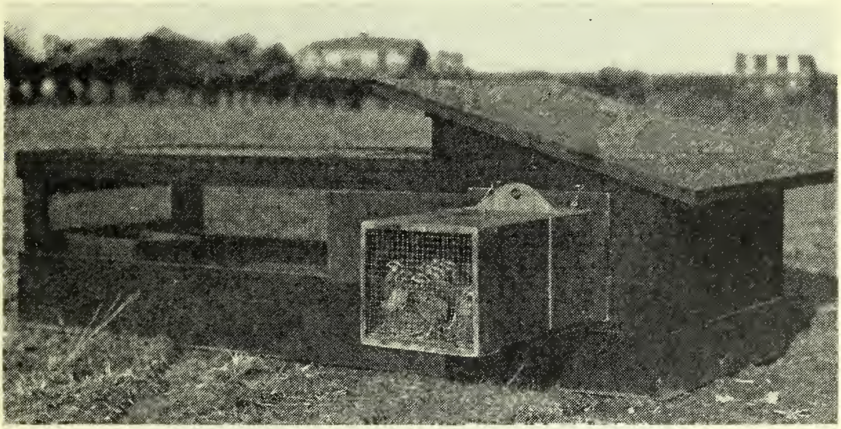
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Figure **34.—Catching box attached to pen.**

The dehydrated alfalfa-leaf meal should be tentative "U. S. extra-green medium" meal containing not more than 18 percent of crude fiber and not less than 19 percent of crude protein. It should have 85 percent or more of leaf particles.

The special steamed bonemeal should contain about 31 percent of calcium and not more than 6 to 8 percent of crude protein.

The soybean-oil meal must have been processed at a high temperature or toasted, but not scorched. This meal tastes cooked, and has a light-brown color.

ADDITIONAL EQUIPMENT

Figures 34, 35, and 36 illustrate and give plans for a catching box that is used to confine about 22 mature quails, for close examination or for conveying them to other quarters. It is hooked to the opening on the side of the shelter of either the holding or the breeding pen. After penning the birds in the shelter, the operator opens the drop door and drives them into the box. The task is made easier if another person is available to shut the door after all birds are in. Figures 37 and 38 illustrate a portable enclosure that permits the breeder to examine and crate his birds and work with them in other ways without their escaping. A bill of material for this enclosure is shown on page 44. A dip net will be of use in catching any birds that escape within the enclosure.

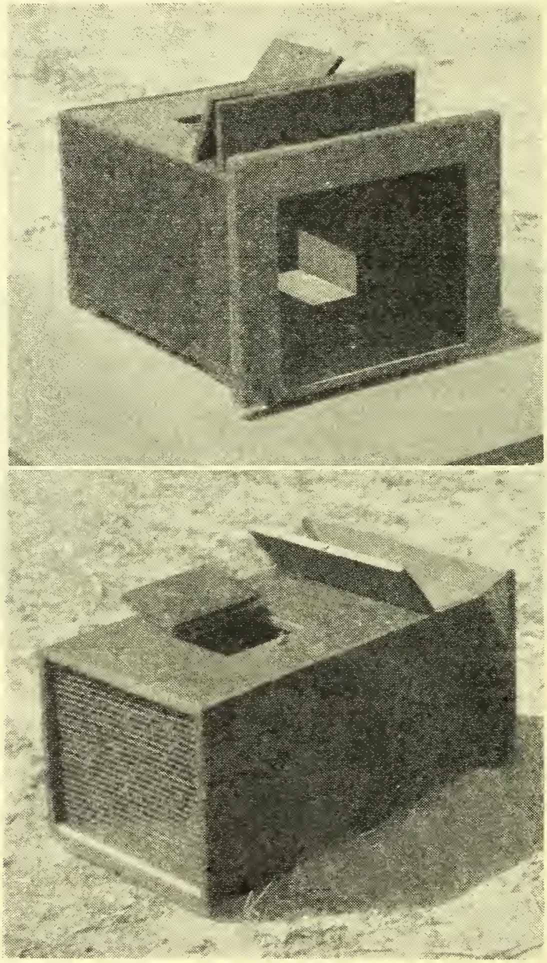

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***Figure* 35.—Catching box in figure 34, detached, front and rear views.**

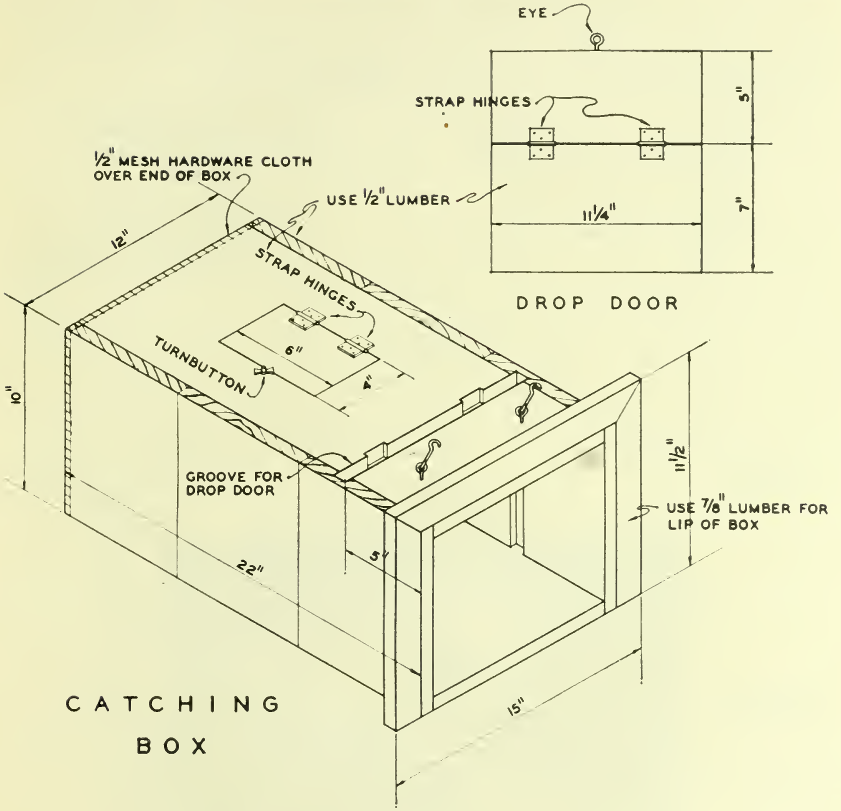

Figure 36.—Construction details of catching box in figure 34.

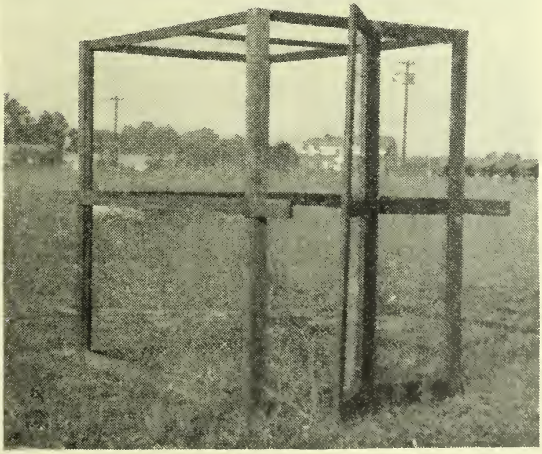

Figure 37.—Portable enclosure used to facilitate handling or crating birds.

BILL OF MATERIALS FOR CRATING ENCLOSURE

Lumber (⅞-inch material when not otherwise specified):
  Frame:
    11 pieces, 3 by 72 inches.
    4 pieces 3 by 3 by 70 inches.
    3 pieces, 3 by 48 inches.
    2 pieces, 2 by 72 inches.
    3 pieces, 2 by 48 inches.
    2 pieces, 3 by 96 inches.
Lumber—Continued.
  Door:
    2 pieces, 2 by 20 inches.
    1 piece, 3 by 20 inches.
    2 pieces, 2 by 72 inches.
Miscellaneous (for door):
    2 steel butts, 3 inch.
    1 turn button, 2 inch.
    1 piece, hexagonal poultry wire, 1-inch mesh, 6 by 24 feet.

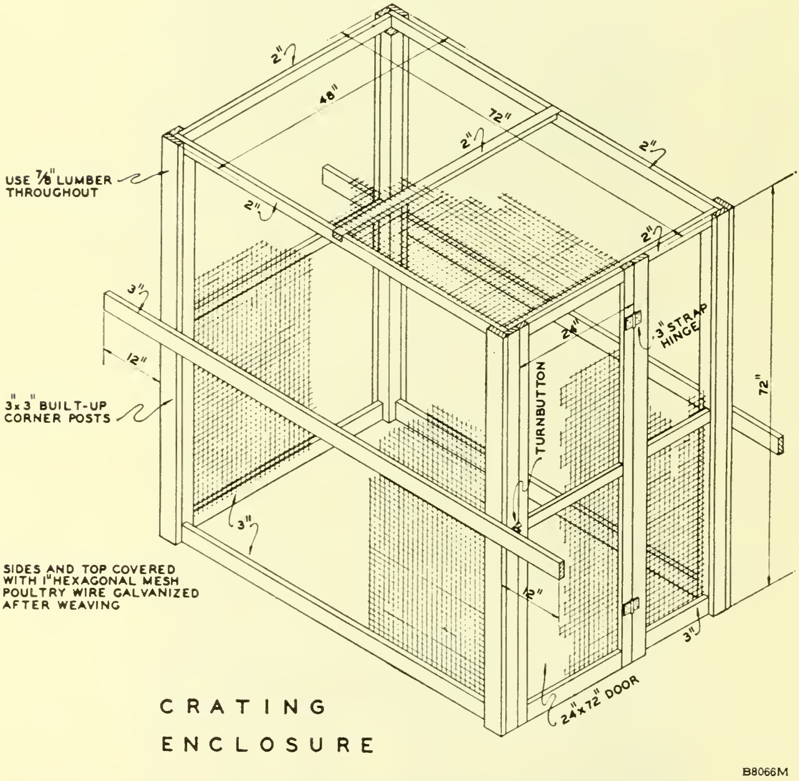

Figure 38.—**Construction details of crating enclosure in figure 37.**

DISPOSAL OF STOCK

Quail propagation is conducted primarily to restock depleted coverts. A breeder therefore plans to release his birds on his own land or else to sell them to sportsmen, State game commissions, or private breeders. If he considers raising quails for food, he should consult his State game commission, as some States have stringent game laws relative to the sale of game birds, either wild or artificially propagated, for food, and a breeder will get into serious difficulty if he attempts to sell to markets, hotels, and the like in States where this is forbidden.

Artificially propagated quails may have difficulty in adjusting themselves to life in the wild. After liberation they are no longer protected, and getting sufficient food therefore becomes a serious problem, especially if they are released where food is scarce. Then, too, their lack of vigilance and quickness may cause them to fall easy victims to predators and hunters.

Spring and summer are the best seasons for liberating birds. An area should be selected that contains good cover and an adequate food supply. If these conditions are met, most bobwhites will stay within a radius of a quarter of a mile. A strip of lespedeza, ragweed, or crabgrass adjacent to adequate cover provides good feeding (figs. 40 and 41). In addition to providing food and cover for the birds, a border strip of sericea lespedeza will stop erosion at the field's edge and will discourage the encroachment of sprouts and tree-root competition in the cropland.

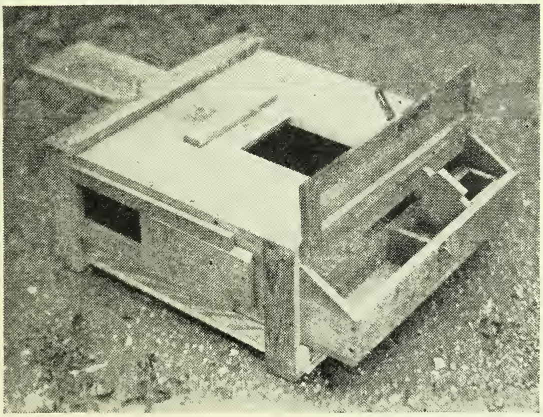

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***Figure* 39.—Quail-shipping crate.**

Bobwhites should be carried to the point of liberation in a shipping crate, which should be placed on the ground with the door facing a thicket. After grain has been scattered and the door opened the birds should be left for a while to allow them to leave the box without excitement and become adjusted to their new surroundings.

If the breeder is raising quails to sell, he should notify the State game commissions and would do well to advertise in the game magazines. Most birds are sold when 10 weeks of age, usually at about $1.50 each. Older birds also may be sold as breeders for about $5 a pair. The shipping crate illustrated in figure 39 is suitable for both 10-week-old birds and breeders. Feed should be provided, and instructions should be given the shipping agent for feeding and watering in transit.

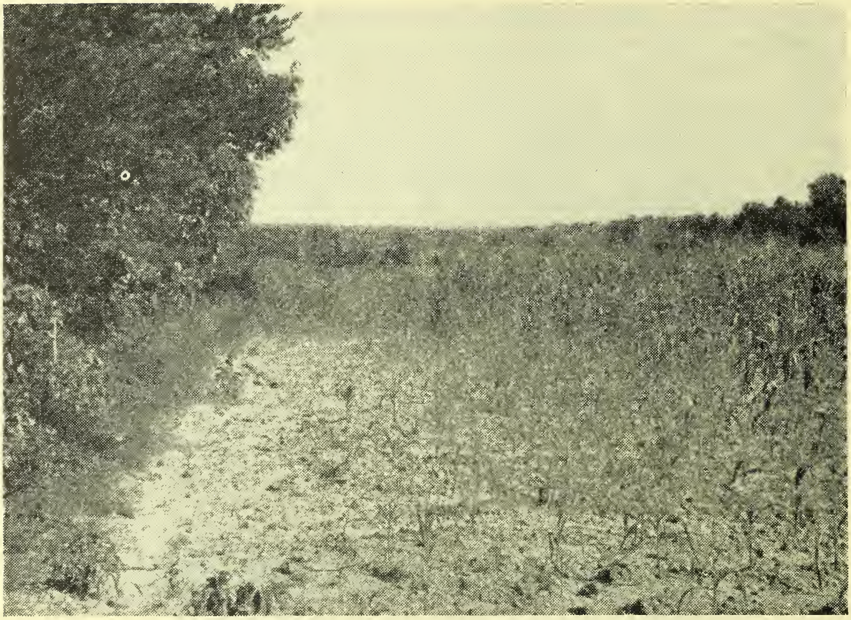

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Figure 40.—Field border before planting quail foods. (Photo courtesy of Soil Conservation Service.)

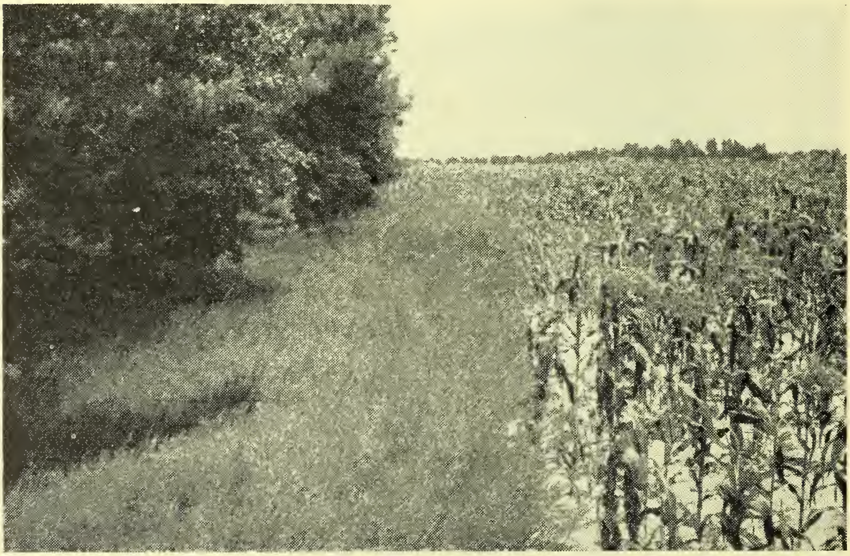

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Figure 41.—The border of figure 39 after planting to lespedeza. (Photo courtesy of Soil Conservation Service.)

WINTER CARE OF LIBERATED BIRDS

Thousands of farms are without sufficient cover and food to hold and support a good population of bobwhites throughout winter. Even where there is an abundance of wild foods, the supply may be exhausted late in winter or made inaccessible by ice and snow. Since bobwhites do not travel widely, under such conditions they may face starvation. A food crisis that lasts a week may cause heavy mortality, and one of 2 weeks' duration may practically annihilate quail populations over large areas.

If farmers wish to have game on their farms, they must provide food that will be available during the critical winter season. This may be done by planting food patches (figs. 40 and 41), and by maintaining feeding stations during emergency periods (fig. 42).

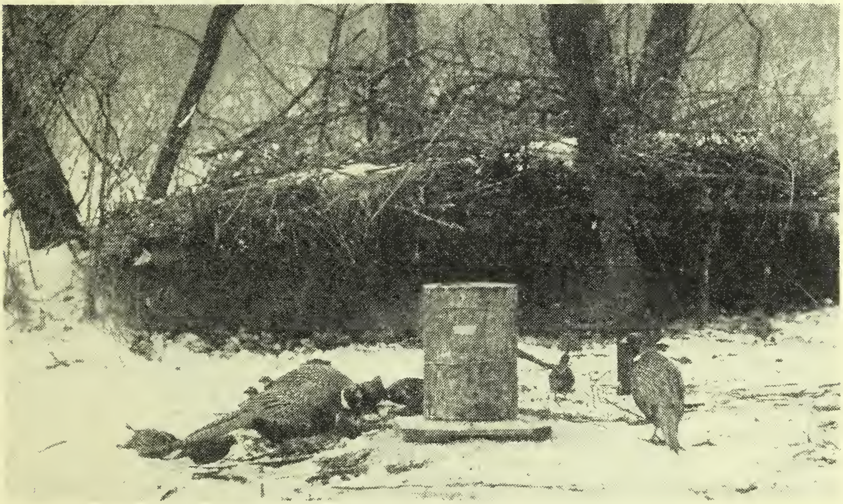

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Figure 42.—Winter feeding station maintained by the Minnesota Conservation Department in 1931–32, when more than 40 bobwhites and many pheasants were fed.

Feed patches are often established on cultivated land; they may vary in size from a quarter acre to several acres. Most farmers, however, do not care to devote a large acreage to supplementary wildlife food crops. It is of importance, therefore, that the plants selected for the food patch should rank high in capacity to produce heavy yields. A number of sorghums, lespedezas, vetches, soybeans, cowpeas, and millets and sudan grass, flax, sunflowers, buckwheat, and corn are so qualified. In regions of severe winter weather, wheat, oats, barley, and buckwheat are not suitable as they have weak stalks incapable of holding the grain above the snow. Thus their usefulness is limited to the fall months and perhaps early winter.

Permanent shelters where grain can be placed make good winter feeding stations for quails, and they should be built close to good cover in areas that are protected from sleet, drifting snow, and wind. Several openings should be left, to allow the birds an easy way of escape from predators.

Feeding stations should be established by November 15, not later than December 1, so that the birds will be familiar with their location and include them within their regular daily feeding range. The stations should be visited regularly and kept supplied with grain. A well-opened corn shock is the simplest and one of the best of feeding stations. Where quails are abundant, at least one feeding shelter to every 40 acres is desirable; in other areas a station may be built near shelter that a covey is known to use. In addition to the wild food that may be picked up, the quantity of grain needed to maintain one bobwhite for a week in severe winter weather is ½ pound. Coarse cracked corn, sorghum, or wheat should be used.

GENERAL PRECAUTIONS

First, from the State game commission, obtain a license and information as to how stock may be legally disposed of.

Quail propagation is not a get-rich-quick business—the breeder must have good common sense and managerial ability.

Do not invest too heavily at the start, especially if in moderate circumstances and with little or no previous experience with game birds. An initial trial with two or three breeding pairs will show what success may be expected.

Separate the quail pens from farm stock and other sources of contamination. As common flies are known to travel 400 feet, place the pens twice that distance from possible sources of infection.

Select for quails an area on high ground with good air and soil drainage. Avoid wet places where mosquitoes breed. Face all pens to the east.

Build a high fence around the area. Predators, as dogs, cats, and foxes, by coming close to the pens may frighten the birds badly even if they cannot reach them.

Keep the area free of tall weeds and grass and otherwise clean. Remove droppings from pens regularly and dispose of them at a distance.

Supply the birds with clean, fresh water daily. Remove the chill from water given to chicks.

Provide the stock with clean, insoluble grit.

Keep feed before the birds at all times. Be sure that it is fresh and free from mold, lumps, or other evidences of deterioration. If commercial mashes are used instead of those here described follow the instructions given by the manufacturer.

If toe picking, feather picking, or similar vices break out among the birds check management practices first, then sprinkle a thin layer of salt over the feed in the hopper once or twice. Try this simple treatment first before attempting other curative measures.

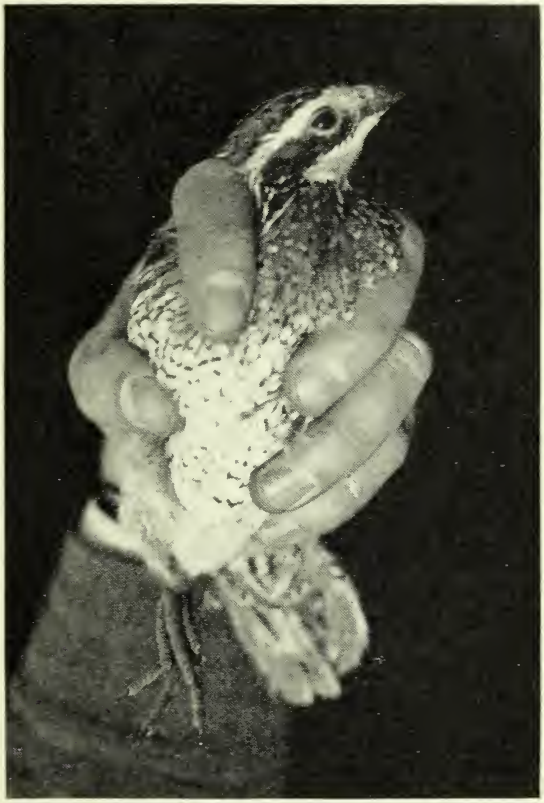

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Figure **43.—Proper way to hold a bobwhite in the hand.**

As a protection against disease keep birds on wire floors off the ground.

Watch the birds closely, especially during the holding period, to see whether any catch their toes on the wire floor. Birds kept on wire do not wear down their claws as they do on the ground. Consequently, these may grow quite long, hooking around the wires and otherwise causing trouble. In this case trim the nails back with fingernail nippers. Also clip the tips of beaks grown too long.

If heavy mortality takes place despite every precaution, send afflicted specimens of both dead and living birds, together with a sample of the feed, to the pathologist or veterinarian at the State agricultural experiment station for diagnosis, and follow his suggestions.

Quails that escape are much harder to catch than chickens. Figure 43 shows the best way to hold them to prevent their leaving the hand. Do not squeeze them. Clipping one wing is not recommended, although it does facilitate capture of escaped birds. If clipping is done, cut off only the primary feathers on one wing. Two months before liberation pull out the old stubs so that new primaries will have time to grow, for to escape predators in the wild, bobwhites must be able to fly.

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